Confidential

FISHERIES RESEARCH BOARD OF CANADA

REPORT

of the

Newfoundland Fisheries Research Station

for

1954

by

W. TEMPLEMAN, Director

With Investigators' Summaries as Appendices

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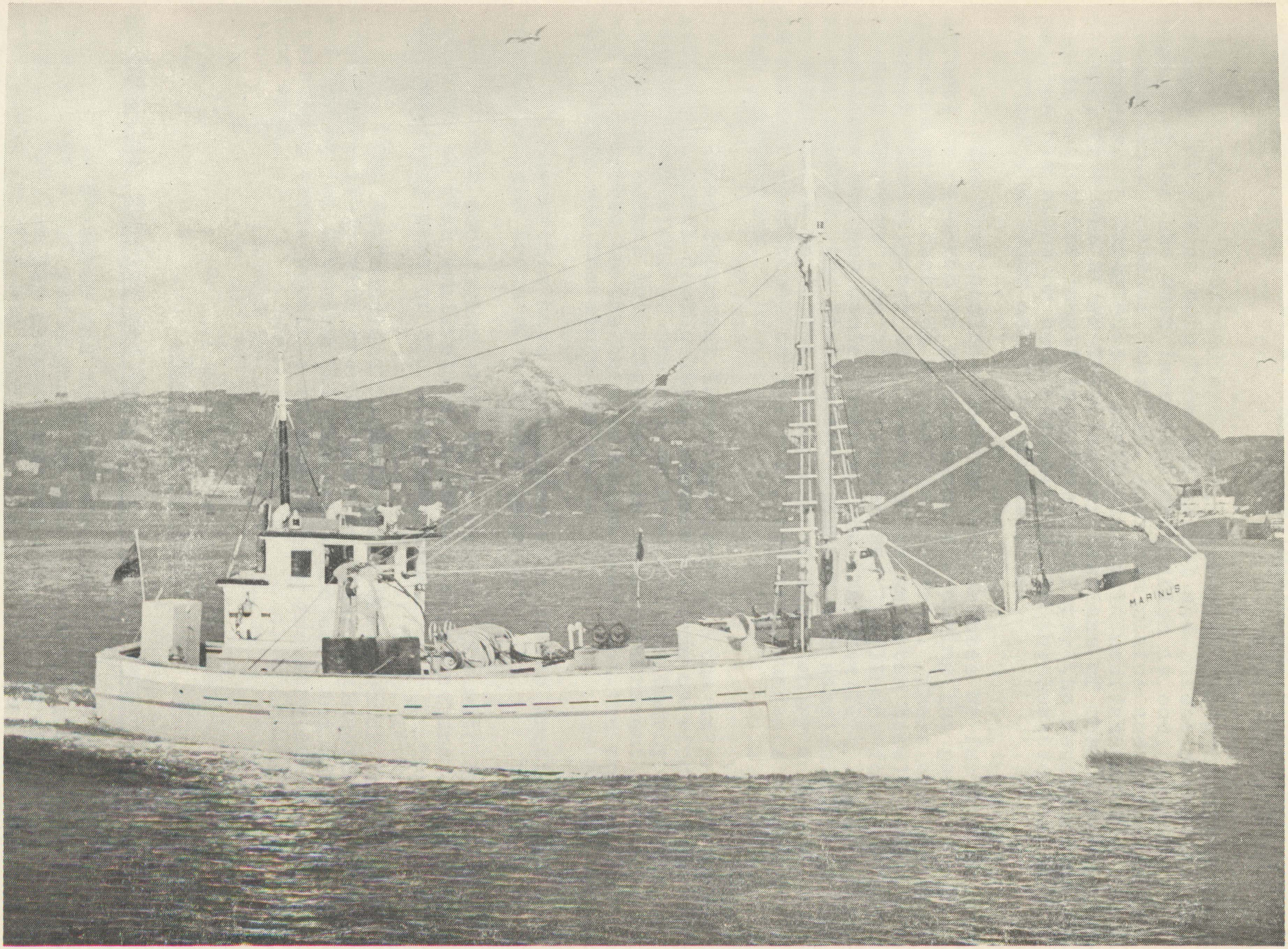

M.V. Marinus

REPORT FOR 1954 OF THE NEWFOUNDLAND FISHERIES RESEARCH STATION, ST. JOHN'S, NFLD.

BY W. TEMPLEMAN, DIRECTOR

In the Newfoundland area, fisheries for groundfish are of most importance both from the actual and potential points of view. By far the most important groundfish is cod. Other groundfishes, haddock, redfish, American plaice and greysole are increasing in importance. Particularly in redfish and American plaice, from the otter-trawling explorations of the "Investigator II", and in cod by the longlining investigations, the Newfoundland Station has aided or been responsible for the location of many new fishing grounds and fish populations.

The Newfoundland Station thus devotes by far its major efforts to research on groundfishes and during the past year has operated seven boats on groundfish research. These are the 82-foot "Investigator II", operated as an otter trawler; the 62-foot "Marinus", an otter trawler and longliner; four 55-foot longliners and one Danish seiner, the "Matthew II". In addition to the seawork, the Station investigates and samples fish landed on shore so as to follow the effect of the fishery and of changes in natural conditions on the size, age and abundance of groundfish populations.

Other important investigations are the salmon investigation, in which during 1954, researches were carried out on the salmon populations of the Bay du Nord and the Codroy river; and the marine mammal investigation, in which at present researches are in progress on the harp and hood seals and the pothead or pilot whale and the minke whale.

Researches have been undertaken on the Arctic char, the commercial sea trout of northern Labrador.

The continuing studies in hydrography with its close relation to fish availability and fish abundance are an important and necessary part of the Station's work.

The Newfoundland Technological Unit, which is associated administratively with the Station, provides engineering services and advice for Governmental fisheries projects and advice and assistance where possible to the fishing industry in the Newfoundland area.

Research in 1954

Explorations Trinity and Conception Bay Deep-water Areas

In November and in early December, 1953, the "Investigator II" was engaged in otter-trawling surveys of the deep water of Trinity Bay between 140 and 200 fathoms which had not been previously studied and surveyed, also the portion of Conception Bay

deeper than 100 fathoms. Redfish were scarce in the deep water of Trinity Bay, the greatest catch in a half-hour's dragging being 250 pounds. The most plentiful commercial fish was the Greenland halibut, locally called turbot. Catches of several hundred pounds of this fish in a half-hour's dragging were usual and four catches ranged from 500 to 1300 pounds.

While the deep water of Trinity Bay is continuous with the deep water of the ocean and is thus warmed somewhat, the deep water of Conception Bay is in a hole, isolated from the warm deep Atlantic water to the east by a broad ledge of less than 100 fathoms. The bottom temperatures here were all -0.9°C. and only very small quantities, usually less than 50 pounds each per drag, of cod, American plaice and Greenland halibut were found.

Haddock

During May and early June a haddock survey by the "Investigator II" was carried out on the southern half of the Grand Bank and on St. Pierre Bank. These surveys are repeated annually at the same stations and at approximately the same time. A shrimp-net lining is used in the cod end and in 1954 for the first time a cod-end cover of shrimp netting was used instead of a liner. By means of the lining and cover the younger year-classes of haddock from one year old and upward are retained and an estimate is therefore possible of the supplies of young fish available to enter the fishery at about five years of age. The cover was apparently much more effective than the liner in retaining the one-year-old fish which were caught in 1954 consistently and in numbers for the first time on these yearly surveys.

The five-year-old haddock of the 1949 year-class were abundant on both banks and were especially dominant on St. Pierre Bank where few large haddock were caught. These five-year-old haddock entered the fishery in numbers for the first time in 1954 and, although small, formed the main basis of a winter and spring fishery, mainly on the Grand Bank, and a summer and autumn fishery on St. Pierre Bank. On the Grand Bank there was little evidence of three- and four-year-old haddock, which apparently did not survive the egg and larval period. One-year-old haddock hatched in 1953 and two-year-old haddock of the 1952 year-class were, however, present in small numbers on the southwest edge and were particularly abundant on the southeastern side of the bank. The one-year-old fish with a peak size at 18.5 cm. and the two-year-old fish with a peak size of 26 cm. will be available as fish of the minimum commercial size in four and three years respectively.

On St. Pierre Bank there was little or no evidence of the year-classes of haddock born in the years 1950 to 1952. One-year-old haddock born in 1953 were in evidence in fair numbers only in one small area on the southern part of the western edge of the bank. On St. Pierre Bank, the haddock, when present either in spring, summer or autumn, are usually concentrated by hydrographic conditions and readily available to the fishery. The

haddock, therefore, can be readily depleted and while there is in 1954 an abundant fishery mainly for five-year-olds, there is at present no evidence of haddock younger than five years in the numbers necessary to maintain this fishery. We can, therefore, confidently expect good stocks of St. Pierre Bank haddock to be available in 1955 and possibly in 1956 but that certainly by 1957 or 1958 the haddock population on this bank will be very much reduced.

The outlook at present on St. Pierre Bank with regard to young haddock to replace the presently exploited group is very much worse than on the Grand Bank.

Redfish

Explorations Gulf of St. Lawrence and Southwest Coast of Newfoundland, 1953-54. In late October and early November, 1953, the "Investigator II" carried out a survey in the northern half of the Gulf of St. Lawrence, to study the distribution of redfish in relation to depth, between 120 and 200 fathoms. All temperatures at these depths were between the small and favourable range for redfish of 4.0° to 5.7°C.

The best catches were usually obtained between 140 and 160 fathoms, although there were occasional good catches at 120 and 180 fathoms.

In the early redfish frequencies obtained in the Gulf of St. Lawrence and on the western part of the south coast of Newfoundland by the "Investigator II" in 1947-50, before commercial fishing for redfish had begun in the area, there was evidence from all the deep-water areas of the presence of an abundance of large redfish mostly between 30 and 42 cm. In 1953, after one summer of commercial fishing in the northern areas of the Gulf and several years fishing farther south, these large redfish were still abundant but, as a group, had essentially the same size distribution. In some cases they were slightly more grouped by some growth in the intervening years occurring at the smaller sizes, while there was no evidence of further growth at the upper part of the frequency. The peaks were essentially the same in 1953 as in 1947 and 1948.

While in the earlier frequencies in the years between 1947 and 1950 there was usually only slight evidence of sizes below 30 cm., there was, in 1953, evidence of a group of redfish with peak sizes between 22 and 25 cm. as well as the larger group in which peak sizes for the males were 34 to 36 cm. and for the females 37 to 38 cm. These two groups of fish were completely separate and with the very slow growth of the redfish there is at least a ten year difference in the ages of redfish at the peaks of the two groups. The younger redfish with peak sizes at 22 to 25 cm. were extremely plentiful on the eastern side of the Gulf and on the western part of the south coast of Newfoundland and were scarce on the western side of the Gulf, north of Anticosti.

It is evident that, in spite of the redfish being viviparous, and in the absence of mortality of spawning fish through fishing, only rarely is there a good survival of redfish larvae to the settling stage in the Gulf of St. Lawrence or on the western part of the south coast of Newfoundland. In the intervening years there is apparently little or no larval settling in these areas. Presumably the redfish in the course of their long larval life in the upper water layers usually drift out of the Gulf.

It is, thus, inescapable that the present large fishery for large redfish in the Gulf is in danger and that when the present group of large fish is depleted, the fishery will depend on considerably smaller fish, since it cannot be expected, with the slow growth and heavy fishing, that the group with a peak of 22 to 25 cm. will reach the average sizes which the present group of larger fish attained in the absence of a fishery.

In Hermitage Bay, through the trawling of the "Marinus", a third redfish frequency peak has been found with peak sizes at approximately 7 1/4 cm., December, 1953; 8 1/4 cm., June, 1954 and 8 3/4 cm. in September, 1954. These fish were most likely about 1½ years old in December, 1953. The presence in this area of three well defined groups of fish will enable valuable observations and checks to be made on the age and growth of redfish. Again there are, judging from growth studies in other areas, about eight years between this younger group of fish and the older successful group of redfish in Hermitage Bay with a peak of 22 to 23 cm. There was apparently very little settling of young redfish in the area in the intervening years. Since the large-meshed trawl nets with a shrimp-net cover probably do not catch the smallest group with any great degree of efficiency, it is difficult to know at present whether this group of tiny fish will represent a considerable stock.

Fishing for Redfish Day and Night. Fishing for redfish usually ceases at night since redfish in many areas rise from the bottom and are no longer available in quantity to the trawls. During the last half of June and the first half of July, two trips were made to investigate the availability of redfish at night. The smallness of the crew and the roughness of the bottom rendered the work very difficult. In the southwest Grand Bank area there were indications that at 160 fathoms, catches were normal from 6 a.m. to 6 p.m. and dropped off to as low as 10 to 15% of the daytime catch by 1 a.m. In the northeastern Grand Bank region at 160 fathoms, a catch of 2300 pounds in a half-hour's drag was obtained at 11.10 to 11.40 p.m. and one of 1200 pounds from 2.35 to 3.05 a.m. These compared with catches ranging from 1200 to 5600 pounds or an average of 3900 pounds during the daylight hours.

Redfish Distribution in Deep Water and Evidence of Restricted Vertical Migration. In September, 1954, the "Investigator II" surveyed, primarily for redfish, the deep water east of Hamilton Inlet Bank in Labrador. A small net, the

three-quarter, 35 otter trawl, was used on a single wire. A series of five drags was carried out at each of five depths from 160 to 400 fathoms. The average catch of redfish per hour's dragging by this small net was 2800 pounds at 160 fathoms, 3400 pounds at 200 fathoms, 2100 pounds at 250 fathoms, 1200 pounds at 300 fathoms and 10 pounds at 390 to 400 fathoms. There is at present no commercial fishery for redfish in this area, but redfish of large size are abundant and have an unusually great range of depth distribution.

Redfish sizes increased with depth with average total lengths of 32.5 cm., 33.7 cm., 35.3 cm. and 39.0 cm. at 160, 200, 250 and 300 fathoms respectively. Some very large redfish up to 60 to 70 cm. were present; one of 75 cm. and 19 pounds was captured. There was an extraordinary difference in the size at sexual maturity of the fish in different depths. Whereas in a sample from 160 fathoms the largest immature females were 37 cm. in length and the smallest mature spent females 35 cm., only five and a half nautical miles distant in 300 fathoms there were no sexually mature specimens in 21 female redfish of 32 to 39 cm. or in 39 of 40 to 47 cm. Bottom temperatures were 2.1°, 3.1°, 3.9° and 3.9°C. at 160, 200, 250 and 300 fathoms respectively. With the higher temperatures, which usually favour early maturity, occurring at the greater depth, the lack of sexually mature specimens at 300 fathoms was apparently due not to temperature but to some other factor such as lack of light.

The area surveyed is the chief centre of infection of redfish in Canadian Atlantic waters by the copepod parasite Sphyrion lumpi. In large numbers of redfish examined at sea at 160, 200, 250 and 300 fathoms the following respective percentages of fish were parasitized by living Sphyrion: 5.8, 6.2, 1.3 and 0.8 and the number of living Sphyrion per 100 fish was 8.7, 9.2 1.4 and 0.8 respectively. These great differences in the distribution of the parasite Sphyrion were in samples of fish only a few miles apart, only four miles in the case of the highly distinct redfish populations from 200 and 250 fathoms. In redfish from 160 and 300 fathom depths from Hamilton Inlet Bank localities, only 5½ nautical miles apart, examined at the Research Station, 8.8% were infected externally with Sphyrion at 160 fathoms and 0.8% at 300 fathoms. The fillets of these samples, each of 120 fish, were examined on a candling table for old heads of Sphyrion. These dead Sphyrion heads encysted in the flesh show evidence of former infections. Internally, 19% of the fish at 160 fathoms and 8% at 300 fathoms had encysted Sphyrion heads. There were 42 encysted heads per 100 fish at 160 fathoms and only 9 at 300 fathoms and this in spite of the considerably greater size of the redfish at 300 fathoms. The living Sphyrion most likely have a life history of at least a year and the differences in Sphyrion distribution in the samples only 4 to 6 nautical miles distant, but 50 to 140 fathoms different in depth, indicate extremely little interchange in the redfish at different depths in the same area and also indicate that the free-swimming stages of Sphyrion and the secondary host, if one exists, are largely restricted to depths above the 250 fathom line.

There was an absence of mature fish at 47 cm. length at 300 fathoms, while at 160 fathoms, five and a half nautical miles distant, the smallest mature female was 35 cm. and all over 37 cm. were mature spent fish. This indicates a lack of mixing for many years.

It appears very likely, therefore, that once the redfish become adjusted, possibly at an early age, to depths of 160 to 200 or 250 to 300 fathoms it is very difficult for them to pass from one of these depth ranges to the other. We have had similar hints of deep water populations of cod living close to shallower water populations and yet having different racial and other characteristics. Highly significant differences in vertebral and fin ray counts have also been encountered in neighbouring populations of redfish but at shallower and at greater depths.

Food. The analysis of redfish stomach contents was continued and 2700 stomachs have been examined. Of this number 20% contained food, 50% were empty and 30% were everted. The main food organisms found were the euphausians Meganyctiphanes norvegica, Thysanoessa raschii and Thysanoessa inermis; the hyperiid amphipods, Themisto libellula and Themisto gaudichaudi and the copepods Calanus finmarchicus and Calanus hyperboreus.

With regard to variety of food contents, 54% contained hyperiid amphipods, 49% copepods, 44% euphausians and 10% contained fish. Of the total volume of food consumed, 36% consisted of hyperiid amphipods, 22% of fish, 20% of euphausians and 16% of copepods, the remaining portion consisting of shrimp, squid, pteropod molluscs and chaetognaths. Compared with the smaller fish there is a change in diet related to the increase in size of the fish. The larger redfish are feeding to a much greater extent on other fish and to a lesser extent on euphausians and copepods, while amphipods still form quite a large part of their diet.

There is also a difference in the feeding habits of fish from different areas. On the southwest slope of the Grand Bank, fish and euphausians are the most important food organisms but on the northern part of the bank and off Hamilton Inlet Bank, amphipods and copepods form the major part of the diet with a smaller amount of fish. In Hermitage Bay, euphausians are present in the stomachs in very large quantities to the exclusion of almost all the other groups while in the Gulf of St. Lawrence, shrimp are the most important food group with smaller numbers of euphausians.

Stomach Eversion. The problem of the eversion of the stomach and the loss of its contents as the fish are brought up in the trawl has been further considered. In all 3926 fish have been examined. Percentage stomach eversion increased with depth, from 30% at 100-149 fathoms to 60% at 300-400 fathoms. Smaller fish showed a greater tendency toward stomach eversion than larger fish.

Groundfish Population Studies

American Plaice. Preliminary population estimates have been made for the population of plaice on the commercial plaice-fishing area of eastern and northern Grand Bank. These were based on otter trawl catches per unit effort and since the trawl catches are not at random but are in the best fishing areas the results are not entirely reliable. The total plaice stock available to the fishery over the area as estimated by this method is from 350 to 1000 million pounds. The theoretical maximum sustained yield is estimated at 46,000,000 pounds approximately and it is estimated that when this yield is attained the catch per boat per hour's dragging will fall to 38% of the present catch per hour's dragging.

Groundfish Landings. Studies are made of catch per unit effort and location of catch of the various groundfishes in order to follow the effect of the fishery on the fish populations. Cod, plaice and redfish landings in Newfoundland during 1953 were lower while landings of haddock and witch flounder were higher than in 1952. Otter trawlers, longliners and Danish seiners increased in number and the number of small inshore boats decreased.

Haddock Discarded at Sea, 1954. It was estimated that up to the end of September, 34% by weight of haddock caught were discarded at sea as being undersized. The true average is probably lower than this since records could not be obtained from the many small draggers which fished close to port and brought in almost their whole catch round.

Landings of Round Haddock. Up to late in 1953, commercial requirements were such that haddock less than about 45 cm. (18 in.) in length were discarded as unsuitable for filleting. However, an extreme scarcity of larger haddock on the grounds became apparent late in 1953 and in the present year. On the advice of the Station, which for many years has been bringing in round haddock under ice with good success, local plants began accepting quantities of the smaller haddock (33-43 cm. or 13-17 in. in length), generally in an ungutted condition.

Detailed records have been obtained from four trawlers. From these ships, about 80% of the haddock landings or about 45% of their landings of all fish up to the end of August consisted of small haddock in ungutted condition. Up to the end of August, also, landings of haddock by these trawlers amounted to over three times their landings of haddock for the same eight months of 1953, and about two and a half times their haddock landings for the whole of 1953. If the small ungutted haddock had not been landed in 1954, landings to the end of August for these four trawlers would have been only just over half their haddock landings up to the same time in 1953 and less than half their haddock landings for the whole of 1953.

Though records for these trawlers beyond August, 1954, have not been fully received, it is known that large quantities

of the small haddock are still being landed. It is, therefore, apparent that haddock landings in Newfoundland for 1954 will exceed those of 1953 because of the inclusion of small haddock, but would have been far below the 1953 landings otherwise.

The difference in the sizes of haddock landed in the two years is striking; the majority of haddock of the sizes landed in 1954 were discarded in 1953.

Commercial Danish Seine Fishery, Fortune Bay. From a beginning in June, 1952, with one boat, the number of Danish seiners fishing Fortune Bay for witch flounder or greysole increased to 5 in 1953 and in 1954 to 7. In June and July, 1954, the catch per drag per boat decreased to the point where other fisheries became more attractive and most of the ships discontinued the Danish seine fishery. There had been some decline also in average sizes.

The smooth bottom area in Fortune Bay, where the main Danish seine fishery occurs, is quite small. Surrounding it is rougher bottom generally unsuitable for seining. It is possible that with intensive fishing the numbers of witch on the smooth bottom area can be reduced considerably and only built up again by immigrant witch flounders from the surrounding rough bottom areas. If this is so, the continued success of the fishery will depend to a large extent upon the rate and amount of immigration of fish into the area from the surrounding areas where fishing does not occur.

Tagging

Between April and October the "Marinus" carried out tagging of ten thousand cod. The tagging areas were Burgeo Bank, St. Pierre Bank, St. Anthony, La Scie, Bonavista, off Cape St. Mary's and off Trepassey. Many varieties of tags were used in the attempt to find the most suitable tags for future work.

From the tagging of 2227 cod at St. John's and 1652 at Fogo in 1950, the average returns in 1954 have dropped to 1%, with approximately 2% for the best varieties of tags.

Using the "Marinus", 199 American plaice were tagged in St. Mary's Bay in June and 289 in September. The "Investigator II" carried out tagging of 1000 American plaice on the northern edge of the Grand Bank in September.

Savings Gear Experiments on Haddock and other Groundfishes.

An experiment was carried out on the Grand Bank under the Development Vote of the Department of Fisheries to estimate the benefits of large-meshed cod ends as compared with the small-meshed (below 3 inches inside measurement) cod ends presently in use. The cod ends ordered had the outside measurements used in

the Georges Bank area and each mesh was presumed to give an inside measurement of 4½ inches. The actual inside measurement wet after use was 4 1/4 inches. Under a limited guarantee against loss of catch, an attempt was made to compare the catches and sizes by one trawler using the 4 1/4-inch mesh cod end and lengthening piece with another exactly similar trawler using the customary less than 3-inch-mesh cod end and lengthening piece.

Large haddock were scarce, most of the commercial haddock present being small, in the 35-46 cm. range, with a modal size of 39 cm. While it was difficult to make exact comparisons, the standard small-meshed gear caught four times as much of these small haddock as the large-meshed gear. Since the plants were accepting the small haddock in the round condition it was unprofitable for the trawler to continue using the large-meshed gear except in the early part of the trip when the haddock were being gutted.

Mesh experiments were carried out on several trips of the "Investigator II" using a small-meshed cover over the trawl cod end. Cod ends of 4 1/8-inch and 3 3/4-inch internal dimensions were used. The 50% selection point at which half the fish escaped through the cod end was for haddock 35-36 cm. for the 4 1/8-inch mesh and 32 cm. for the 3 3/4-inch mesh. For cod and redfish, the measurements were much fewer than for haddock and only indications of the 50% selection point were obtained: for cod 36 cm. for the 3 3/4 inch mesh, and for redfish 29-30 cm. for the 4 1/8 inch mesh and 28-29 cm. for the 3 3/4 inch mesh.

Records of Unusual Fishes, 1953-1954

The following unusual fish records were obtained from the Newfoundland area, Bathylagus benedicti; Polymixia nobilis; the deep sea angler, Himantolophus groenlandicus; the grenadier, Trachyrhynchus murrayi; the wolf eel, Lycenchelys verrilli and the European ling, Molva molva.

Herring Mortalities in the Gulf of St. Lawrence

Reports in late July of large numbers of dead herring floating in the inshore areas of the west coast of Newfoundland from St. George's Bay to Port aux Choix were investigated early in August.

A few dead herring were picked up floating near Bay of Islands where a herring school was seen. Examination of these herring showed no skin lesions of any kind and no internal sporozoan cysts. However, the stomach sacs in all specimens were tightly inflated with gas, there was no food in the stomachs, and the intestines were full of greenish amorphous material.

Plankton tows in the area where the dead herring were picked up showed an abundance of calanoid copepods, and there were present also Ceratium sp. and Rhizosolenia sp. Temperatures

in the inshore area were fairly high compared with temperatures in deeper water where the herring had spawned, presumably in late spring. The movement of these herring inshore in late summer instead of in the spring was unusual.

It was presumed in view of these circumstances that the herring fatalities had occurred through ingestion of toxic food, most likely of phytoplanktonic origin, incidental to feeding on copepods.

Later some of these herring were sent to Dr. Margolis of the Nanaimo Station and no indication of disease organisms was found.

Atlantic Salmon

Bay du Nord River. The entire outward smolt and the adult returning salmon runs were caught by a net fence and a wooden trap. In all cases the fish were marked and sampled for scales and size. The fence was in complete fishing order on April 30 and the first smolts were taken May 7. The last smolt was taken on June 29 and the fence was removed July 1.

The total count for this year was 8264. Two-thirds of the run occurred between May 7 and May 26 with a peak number of 1232 on May 21 while one-third appeared from May 27 to June 29 with a peak number of 336 on June 1. The high daily counts were from May 19 to 22 inclusive with 872, 610, 1232, and 979 respectively.

The water temperature was approximately 7°C. for several days preceding the start of the run in both 1953 and 1954. In both years there was a heavy or medium rain on the peak day and a heavy rain on the preceding day.

The size range of smolt fork lengths in 1954 was 131 to 374 mm. compared with 132 to 291 mm. in 1953. In 1953 the largest numbers of smolts were in the 157 to 163 mm. range, and in 1954 the largest numbers were in the 163 to 171 mm. range.

Of the 8145 smolts marked, 6787 were tagged and 1358 fin-clipped. All tags were attached immediately in front of the dorsal fin. The fin-clipped smolts had the adipose fin and the posterior half of the dorsal fin removed. Of the 31 tags returned to date two only were from outside the Bay du Nord River and Estuary; these were both taken in Fortune Bay. One was caught in a salmon net at Hare Harbour, a distance of 18 miles from the tagging point, 39 days after being tagged. The other was angled a short distance up Terrenceville Brook, a distance of 40 miles from the tagging point, 69 days after being tagged.

Only four smolts of the 1953 smolt marking have been accounted for so far. One tagged and two fin-clipped smolts were caught at the smolt fence and released again this year during the smolt run. Apparently they remained in the river another year after being released in 1953. The other recapture was a fin-clipped grilse which returned to Bay du Nord River and was passed through the salmon counting fence on July 8.

During the operation of the smolt fence the largest numbers of kelts descending coincided with the peak of the smolt run. In 1953 the kelt peak was a week earlier than the smolt peak. The total number of kelts passed through the smolt trap was 58 as compared with 56 in 1953. Twenty-four had tags attached from 1953 tagging, 4 had wire only, 6 had scars where tagged, and 24 had not been tagged. In 1953, 97 of 151 salmon and grilse entering the river were tagged. Of this number 5% of the kelts tagged in 1953 were caught in the commercial fishery of 1954, two in Placentia Bay and three in Fortune Bay, all to the east of Bay du Nord River.

The total count of salmon and grilse entering the river for the 1954 season was 55 compared with 151 in 1953. The trap, however, was not operated after August 7 and 36 salmon and grilse entered the river after this date in 1953. Thirty-four salmon and 21 grilse entered in 1954 compared with 53 salmon and 98 grilse in 1953.

Little Codroy River. The Atlantic salmon research program for 1954 on the Little Codroy River had two main objectives. One was investigation of the utilization of the salmon stock in sport and commercial fisheries; the other, the study of size and age-class composition of the salmon stock in order to provide basic information on the character of the fishery. This is a long-term project and is part of an overall Atlantic salmon program which includes investigations in the Miramichi River in New Brunswick and in the Port Daniel River in Quebec.

A counting fence was located in the estuary of the Little Codroy River, below all tributaries, about one mile from the ocean and about three miles below the upstream limit of brackish water. The river at this site is 810 feet wide. During the period that the fence was in operation, the depth of water in midstream - where the traps were located - varied from 6.5 feet to 8.5 feet. The rise and fall of the tide within the estuary was about one foot. The counting fence for smolts was completed May 14 and remained in good fishing order for the duration of the season. As soon as the fence was put into operation, a smolt was captured and it is felt, therefore, that the seaward migration of smolts had already started by that date. The migration built up very slowly to a peak of 541 on June 6, declined to 87 on June 9; then rose to a second peak of 1280 on June 12, declined to 146 on June 18; and then rose to a third peak of 837 on June 22, and declined rapidly thereafter. The last migrant was counted July 14, and the fence was removed July 18. The total count of smolts for the period that the fence was in operation was 12,210. All the smolts were marked by removal of the dorsal and adipose fins.

The seaward migration of kelts occurred at the same time as the smolt run. The peak migration was on May 23 and the total kelt migration 253.

The first inward migrating salmon was caught June 18 and the last on October 9. The total run was 215 fish, consisting of 4 in June, 165 in July, 40 in August, 1 in September, and 5 in October. Twenty-six per cent of the salmon which migrated upstream were caught by angling.

Arctic Char

The material on Arctic char collected in Labrador in 1953 has been studied. The ages of these sea trout caught in gill nets in the sea ranged from 5 to 19 years. In the most southerly sample, at Adlatok, the mean age was 8.4 years.

Proceeding northward the average age gradually increased to 10.7 years at Ramah. The mean weight and length, however, were greater at Adlatok (4.4 pounds, 57 cm.) than from Nain to Ramah (2.1 to 3.0 pounds, 47-48 cm.). Growth was correspondingly more rapid in the southerly part of the char range in Labrador than in the northern part. Vertebral frequencies increased from 64.45 at Adlatok in the south to 65.47 and 65.28 respectively at Hebron and Ramah in the north and indicated distinct char populations.

The greatest difference in racial and most other characteristics was between Adlatok and Nain to the south which lie in inland sheltered waters, and Hebron and Ramah to the north which are exposed and close to the open ocean.

Marine Mammals

Harp Seals. Investigations of harp and hood seals were carried out in the Gulf of St. Lawrence and at the Front during a seven week trip on the sealing vessel "Theron".

One hundred and twenty white-coats were tagged during March in the Gulf. From the 1952 and 1953 tagging of young harp seals, two returns of seals in their first year from west Greenland on January 22 and February 9, and one from Cape Bauld at the extreme north of Newfoundland in mid-January show that some seals remain in the Arctic until quite late in the winter while some migrate south with the adults. Two tags from immature harps were returned from the east coast of Baffin Island in the Canadian arctic. All previous recoveries from north of Labrador had come from west Greenland.

In the moulting patches, mature females were found to be scarce and immature seals and old males plentiful until late April when females increased in number. This observation is important since closing the sealing season by April 20 would have protected the mature females in the moulting patches in 1954.

Consideration of age readings from teeth obtained both from land-stations and from the sea fishery indicates good survival for the 1950 year-class and poor survival for the 1951 and 1949 year-classes. It may be argued that the low survival of the 1951 year-class was due to the very high catch of whitecoats in the spring of 1951. However some other factor must be responsible for the low survival of the 1949 year-class. In 1949, the kill of whitecoats was only average, approximately the same as that of 1950 which left a good year-class.

Minke Whales. There has been an opportunity to study small numbers of the minke or lesser rorqual whale. The meat of this whale is excellent human food. Small numbers of these small whales are harpooned in Trinity Bay. Minke, in this bay, follow the capelin inshore and feed almost exclusively on them.

Males measured 15 to 28 feet with a mean of 24 feet and the females 16 to 30 feet, again with a mean of 24 feet. Females were recorded as pregnant from 25 feet and upward; seven males 23 to 27 feet were sexually mature. Breeding season, size, size at maturity, size of foetus and body proportions, as far as could be determined from small samples, were similar to those of the Norwegian stock which supports a large fishery.

Pothead or Pilot Whales. A fishery for these small whales takes place at Dildo, Trinity Bay, and spasmodically in Bonavista and Notre Dame Bays. The catch in 1954 was considerably smaller than in 1952-53 when three to four thousand whales were caught. A few large potheads are harpooned but almost all are diven ashore. They feed exclusively on squid and can only be expected inshore in numbers in years when squid are abundant. Driving began on July 16 and about 1100 whales were taken in drives up to August 10. Thereafter the whales became scarce, only one drive being made in September. Several drives, however, took place between October 29 and November 8. One drive occurred in Bonavista Bay on October 18. Coupled with the only moderate abundance of pilot whales in Trinity Bay, there was a widespread dispersion of both squid and pilot whales northward as far as Hamilton Inlet Bank.

Growth has been studied by sectioning of teeth. Immature males and females grow at the same rate. At 6 years when most females are mature and all males are immature the size of both sexes is about 12 feet. Males mature sexually at about 12 years and at this time the male shows an increased rate of growth which results at 20 years of age in a mean length of 18 feet for males and 15 feet for females. In measurements of about 3000 potheads the largest females were 16 feet 9 inches and the largest males 20 feet in length.

Hydrography

Hydrographic work is carried out as a necessary background for the various investigations, particularly those of groundfish. The usual stations in the southern part of the area were occupied by the "Investigator II" in April and the six sections across the Labrador Current and across the banks from Labrador southward in July-August. A station off St. John's was taken monthly or more often and daily surface temperatures taken in St. John's harbour.

In the Labrador Current from Labrador to Cape Bonavista and in the inshore branch of the current from Cape Bonavista to the southern edge of the Grand Bank, there was a considerably greater volume of below zero water present in July to August, 1954, than in the same period of 1953.

In the channel between the Grand Bank and Green Bank and particularly at the entrance to the channel between Green Bank and St. Pierre Bank, there was more below 0°C. and below -1°C. water present in August than in April.

On the southwest slope of the Grand Bank, in the line of stations at 275 metres, the highest temperature recorded in April was 12.98°C. The water with temperatures of over 12°C. occurred at 100 to 150 metres near the tail of the bank in Longitude 51°W. to 52°W. Also at these depths and deeper, water with temperatures of 10°C. extended to Longitude 53°W. and over 9°C. water west to 54°W. There was thus a transgression of unusually warm water on the southwestern edge of the bank but since the warmest layers were below 100 fathoms there was no evidence of it on the line of 40-fathom stations a few miles to the northeast, paralleling the southwestern fringe of the bank. The April temperatures in this section in the deep water of the southwestern slope of the bank in 1954 were 3 to 4°C. higher on the average than at the same period in 1953. From the 25-metre level downward the highest temperature in August in this section was 8.21°C. Excluding the extreme southeastern edge, bottom temperatures in the section were 2 or 3 degrees lower in August than in April, 4.3 to 6.4°C. in August as against 6.7 to 9.5°C. in April. Similarly in 1953, water temperatures below 50 metres at the southwestern edge of the Grand Bank were several degrees lower in August than in April due to the arrival in the intervening period of new supplies of colder water from the north.

Hydrographic Conditions and Fishery 1954. During the summer of 1954 the cod were more abundantly available to traps and handlines close to shore on the east coast of Newfoundland than they had been for many years. Even the oldest fishermen in many areas could not remember when cod had been so close to the shore in such large numbers and for such a long period of the year. From June to the end of September and even later, cod were available in quantity on the east coast in much shallower water than is normally the case. The summer was marked by much calmer weather than usual and a stable shallow layer of surface water built up. As an illustration, in the hydrographic station five miles off Cape Spear near St. John's, due to the lack of mixing by the wind and sea, the 0°C. layer remained at twenty fathoms until the end of August and the 3°C. line above 12 fathoms until early September. As a comparison, in 1953, a typical year, the zero line was at 20 fathoms at the beginning of June and below 50 fathoms by the end of August. Most of the inshore cod keep above the zero line but may be caught in numbers up to 4°C. or even higher. The unusual hydrographic conditions therefore offer a convincing explanation of the unusual abundance of cod very close to the shore. Apparently the cod approached the shore in late June following the capelin and as usual took up bottom feeding when the capelin moved off. While bottom feeding they were restricted to the favourable temperature area close to the shore which did not expand significantly in depth during the months of July and August. There have, however, been other years with a shallow zero line in July and August without such a great abundance of cod near shore. The much greater amount of rainy and foggy weather than usual in July and August was also favourable to the residence of the cod in shallow water. It is possible also

that the reduction of inshore fishing in recent years has resulted in a considerable increase in the cod population. Such an increase would also be accompanied by an increase in size. In this connection it was evident in our measurements at Bonavista and reported from many other areas that the trap cod were considerably larger than usual in 1954. While more plentiful at headland areas, cod were far less plentiful than usual in many areas in the bays. Doubtless this was also related to the hydrographic peculiarities, but hydrographic information for the bay areas is lacking. Squid were plentiful and came in earlier than usual. Evidently moving in the warm surface layers, the presence of the cold layer close to the surface had no unfavourable effect on their migration and may have speeded it by reducing vertical movements. Squid were reported in unusual numbers at Battle Harbour, Labrador, and by the "Investigator II" in the Hamilton Bank area of Labrador.

Danish Seining

The Danish seining experiment to discover new commercial grounds for this fishery was begun in 1953 and continued in 1954. The work was carried out with the 56-foot "Matthew II", loaned by the Province of Newfoundland and with expenses paid under the Development Vote of the Federal Department of Fisheries.

Newfoundland. In Newfoundland waters, areas were investigated between Ramea and Miquelon, in Placentia Bay, in St. Mary's Bay, in St. George's Bay, Conception Bay, Trinity Bay, Bonavista Bay, the area off the Funk Islands, Green Bay, the area near La Scie and White Bay. No commercial fishing areas for Danish seining were found in any of these places.

North Bay. In response to a request from the Atlantic Biological Station, the Gulf of St. Lawrence area called North Bay was investigated in the autumn. North Bay is the name used by local fishermen for the sea area west of Cape Breton Island and east of the Magdalen and Prince Edward Islands. In this region, between 46°20'N. and 46°40'N., and 61°25'W. and 61°42'W., a large area of bottom suitable for Danish seining was found. Between depths of 32 and 37 fathoms, five sets were made. All produced excellent results, with catches varying from 4000 to 9000 lb., consisting of grey sole and American plaice.

The grey sole catches were 1000 to 3000 lb. for each set; these fish were all large, the average length of fish for the various sets ranged from 48 to 54 cm. American plaice made up the bulk of the catches, as much as 7000 lb. to one set, and were mainly fish of a good commercial size. Small amounts of scrod and small market cod were also caught.

The good ground was situated on a bank, on the western side of a deeper channel which runs parallel with the Cape Breton

coast. The bottom appeared to be very level and to consist of fine red sand. As the time available was limited, and weather conditions very unfavourable the area could not be surveyed exhaustively, but fathometer recordings indicated good bottom in much of this region.

It seems probable that the area would support a successful commercial Danish seine fishery for grey sole and American plaice, as Danish seine is probably more efficient in catching these fish than the otter trawls at present used on the grounds.

During one set further north, at 46°55'N., 61°09'W., in the same depth, the gear caught on the bottom, which was rougher. A set in shallower water (20 fathoms) caught 300 lb. of yellowtail flounder and 100 lb. American plaice. The catch in over 50 fathoms was mainly grey sole and American plaice, but the fish were smaller, (average length of grey sole 47.4 cm.), and only totalled 900 lb. The bottom of the channel east of these grounds was too uneven to fish.

Longlining

Since 1950, the Station has been engaged in longlining experiments in Newfoundland waters, using money supplied by the Department of Fisheries under its development vote. As a result of this work much of the suitable coastal waters of the Newfoundland area has now been surveyed during experimental fishing by longliners. A very great area of new fishing ground has been found in deep water with abundant supplies of large cod. These cod had been almost entirely unutilized until their location was demonstrated by these experiments. As a direct consequence of the experiments, longlining is firmly established at Bonavista where 15 commercial boats are now fishing the new grounds. One major difficulty must be resolved before the costly longlining boats can operate efficiently and this may be accomplished in the near future at Catalina. This necessity for profitable longlining operations by expensive boats is the provision of a plant which places the interests of the longliners first and co-operates to increase their efficiency. No other type of groundfish plant operation makes as much economic sense on the northeast coast between Baccalieu and Cape Freels as a frozen-fillet fish plant operated primarily for longliners and allowing no other type of fishery to interfere with the interests of these ships. A good harbour wellequipped with navigation aids and with shore facilities such as a small slipway is, of course, a necessity for successful longlining.

In 1954, the longlining experiments were carried out vigorously. Three 55-foot and one 51-foot Robar-type Nova Scotian boats were used. The skippers were from Lockeport and Louisburg and some of the crew members were Newfoundlanders. The boats were "Ada and Bill", Captain Hector Smith, "Atlantic Rover", Captain Russell Decker; "Gertrude and Ronald", Captain Gordon Hemeon; and "Pat and Judy", Captain Joseph Atkinson.

The Captains were all experienced and successful longline fishermen and each boat carried a crew of four including the Captain.

These boats fished large ranges of depths in all areas but concentrated on depths which, on the basis of previous experience and prevailing hydrographic conditions, were expected to yield good catches.

Catches were sold whenever possible but the sale of fish was not allowed to interfere with any of the experiments.

The standard gear used by the boats consisted of tubs of twelve fifty-fathom lines with hooks six feet apart.

Squid was used for bait in all the experiments, except for a period during the experimental fishing in the Twillingate-La Scie area when capelin was the only available bait.

Commercial Test of Longlining at Ramea. Two boats, the "Atlantic Rover" and the "Gertrude and Ronald", fished from Ramea on the south coast of Newfoundland from January 15 to April 14.

Cod catches were low in all areas throughout the experiment. The best catches were on the northern and western edges of Burgeo Bank in March, (averaging 600 lb. per tub). In January and February they averaged only 390 lb. per tub and in April 420 lb. per tub on these grounds. On the inshore grounds, within ten miles of Ramea, they were low throughout the period, averaging from 300 to 360 lb. per tub in the four months. On Banquereau Bank (the name given locally to the small bank situated between Burgeo Bank and Ramea) catches averaged 370 lb. per tub in February, 415 lb. in March and 200 lb. in April. On Grey River Bank the cod catches averaged 390 lb. per tub in March and 480 lb. in April.

The greatest total number of trips (26) for the two boats was to the inshore grounds which could be fished on days unsuitable for offshore fishery. Twenty-four trips were made to Burgeo Bank (17 of which were in March and April), fourteen to Banquereau Bank and five to Grey River Bank in March and April. Ten of the trips to Banquereau Bank were made in February.

The best cod catches were consistently made in depths of 60 to 85 fathoms in all areas, but, with the exception of Burgeo Bank, the Captains found great difficulty in keeping their gear in these depths. On the inshore grounds, Banquereau Bank and Grey River Bank, the shoal water areas are small and very irregular.

Fishing under commercial charter with the men retaining the value of the catch, excellent and strenuous fishing efforts were made even under stormy conditions. The weather was extremely unfavourable for a great part of the period. The fishing intensity steadily increased during the experiment as

the lengthening period of daylight allowed more gear to be fished. The Captains always finished fishing in time to reach Ramea Harbour before dark, as stormy weather and frequent heavy snow showers often reduced visibility to almost zero. The boats fished an average of 5 tubs of gear per trip in January, 6 in February, 7½ in March and 9 in April. The greatest amount of gear fished by either boat in one day was 10 tubs.

Catches were between 30,000 and 46,000 pounds of marketable fish per complete month. Fish other than cod made up 9% by weight of the total catch (15% value) and, of this 9%, two-thirds consisted of haddock. Very few plaice were caught and wolffish catches were much lower than in the experimental fishing in this area in May and June, 1953.

Prices were somewhat higher than in the summer but, as the monthly catch was only about 20% of that on the northeast coast of Newfoundland from May to September, there was no evidence of commercial success for these costly boats. In terms of fishing ability and fish caught, however, the longliners outfished the local jack-boats. In January three local jack-boats were longlining from Ramea, setting and hauling their gear from dories, but by early March two had stopped fishing and the third made only six trips in this month. Throughout the experiment these jack-boats fished many days less than the chartered boats (the result of their method of fishing and the extremely bad weather) and consistently caught less fish per comparable amount of gear.

Commercial Test of Longlining at Badger's Quay. The "Gertrude and Ronald" and the "Ada and Bill II" carried out a commercial longlining test at Badger's Quay near Valleyfield on the north side of Bonavista Bay, in an area where experimental fishing in 1952 had indicated that there were excellent deep-water fishing grounds to the east and north. Here they were operating under certain disadvantages from lack of shore facilities. Cod catches were excellent throughout the experiment which lasted from June 1 to October 12. The June catch suffered in the first quarter of the month from lack of fishing due to ice conditions.

The boats found excellent deep-water fishing grounds 19 to 25 miles E. by S. of Badger's Quay. In the autumn with shorter days and stormier weather, the boats moved inshore and found good fishing on the shoal-water grounds 3 miles N.E. of Cabot Island. On the offshore grounds the best range of depths was usually 125 to 150 fathoms and on the inshore grounds, which were fished from September 11 to October 12, the best catches were in 20 to 35 fathoms.

Cod catches were excellent throughout the experiment. On the offshore grounds, the "Gertrude and Ronald" averaged 1380 lb. per tub in June, almost 2000 lb. per tub in July and August and 1439 lb. per tub in September. On the inshore grounds this boat averaged 1500 lb. per tub in September and 1476 lb. in October.

Fishing began on June 1 and ended October 12. Fish were still plentiful when the fishing under charter ended. During the fishing period, Captain Hemeon in the "Gertrude and Ronald" caught 856,000 pounds of marketable fish, of which 834,000 pounds were cod, mostly of large size. The total value of all cod caught by this boat at 2¢ per pound head-on gutted was $16,720 and of all commercial fish $17,189. Since there was no fresh fish plant, the wolffish, plaice and halibut included in the latter calculation were not sold and do not enter into the following estimates of earnings. The gross stock therefore was $16,720 from the sale of cod only, the boat's share at 25% of the gross was $4180, the expenses $3691, the net stock $8860, and the share for each of the four men $2213 for the approximately four and a half month fishing period.

The "Ada and Bill II" in the same fishing period beginning June 10 and ending October 12 caught 587,000 pounds of fish, of which 573,000 pounds were cod. The gross stock was $11,463, the boat's share at 20% was $2292, the expenses $3271, the net stock $5899 and the share per man $1474.

The Badger's Quay-Valleyfield area is close to what may be the best and most extensive longlining grounds in the Newfoundland area, extending from the area 19-25 miles from Badger's Quay, fished in the present year, to and around the Funk Island area to the north. The latter grounds could only be fished profitably on trips using ice and lasting longer than one day. They will probably be used by the larger boats when fishing pressure builds up on the nearer grounds.

Experimental Longlining, Bonavista Bay-Funk Island Area. During June, 1954, the longliners, the "Atlantic Rover" and the "Pat and Judy" repeated and extended the experimental fishing of 1952 in the deep water, from the head of Bonavista Bay on the north side to the Funk Island area. Catches in the bay were not high. Good catches were obtained at the mouth of the bay, southeast of Badger's Quay, and from that point to the Funk Island area, where again as in 1952 the best catches were obtained, averaging 1500 pounds per tub in all sets. In the Bonavista Bay area the best cod catches were in depths of 130 to 155 fathoms, and in the Funk Island area in slightly deeper water.

Experimental Longlining, Twillingate-La Scie Area. From July 4 to August 1 the only available bait was frozen capelin and cod catches in this period were low, averaging only 385 lb. per tub on the deep sets. The best catches with this bait (up to 850 lb. per tub) were obtained on the southeast edge of the bank which extends east from Cape St. John.

In August, with squid bait, cod catches were much higher on all the grounds fished. Excellent catches (1500 to 2000 lb. per tub) were obtained along the southeastern edge of the bank which extends south from the Grey Islands. Good to excellent catches were obtained along both sides of the bank

which extends east from Cape St. John, with the best catches being made on the western half of the bank.

Cod catches in Notre Dame Bay and in the deep water west of the bank which extends south from the Grey Islands were low on all sets, with both squid and capelin as bait.

Moderate to good cod catches were obtained on squid bait, in the deep water within 8 to 15 miles of Twillingate.

The best cod catches were generally obtained in depths of 120 to 160 fathoms, the best fishing depths varying during the experiment and in the different areas fished. Cod catches were in general lower than in the experimental fishing carried out in this area in 1952.

Experimental Longlining, St. Mary's-Trepassey Area.

Cod catches were excellent in September and October in almost all the sets made in this area in depths of 20 to 45 fathoms. The best catches were obtained on Ballard Bank, the grounds off Cape Race and on St. Mary's Bank.

Several sets were made in deep water (55 to 112 fathoms) in St. Mary's Bay and catches on these sets were low, ranging from 190 to 800 lb. per tub. The lowest bottom temperature in this Bay was -0.3°C. Two sets were made in water of intermediate depths off Fermeuse and, as was expected, cod catches on these sets were almost nil.

There were many banking schooners and draggers operating in this area in October, and on several occasions the experimental boats could not set their gear in the best range of depths because of the presence of these commercial boats, resulting in below average cod catches on these sets. The grounds off Cape Pine had been intensively fished by draggers, and cod catches in sets on these grounds were low.

In the St. Mary's to Trepassey area and indeed in the area from Cape Race to St. John's there is no deep warm water below 120 fathoms close to the coast offering possibilities of early spring and summer fishing such as occurs from Trinity Bay northwards. Longlining in these areas must depend on the small boat inshore-shallow-water fishing area. Of these inshore shallow-water areas the region from Ballard Bank to Cape St. Mary's is more favourable to longlining than most coastal areas, because of the extent of the shallow coastal waters. While doubtless in these areas it will be profitable to longline in August and in the autumn, longlining success in the early months of the year remains problematical since most of the fish are close to the coast and, in such areas where traps, handlines and hand trawls are numerous and efficient, the longliner with her four to eight miles of gear is at a disadvantage.

Newfoundland Technological Unit

Bonavista Experimental Salt Fish Plant. The Technological Unit was responsible only for general engineering service, major installations and maintenance for the past season.

A second Baader header-splitter machine was added during the year; the cool room capacity was expanded by about 75%; a new mechanical washer was added, air conditioners were installed in the dry store.

Members of the staff made numerous trips to Bonavista to install equipment and expand facilities, to correct mistakes and to repair defective machinery. Both the mechanical and electrical ends of the splitters gave trouble resulting in break-downs and loss of production.

The fish produced has been, for the most part, of very high quality with a high percentage of Italian grade in the lightly salted fish. The reports from the markets in Italy have been excellent. Production figures should be 50% above those of 1953; production probably would have been considerably increased if strikes had not curtailed the intake at the plant.

It is hoped to modify some processing practices before the 1955 season and so lower the cost of production.

Andrews' Washer. A revised model of the Andrews' washer was constructed for trial operation at Bonavista. It has performed well and has cut the cost of the hand-washing of the previous season by about two-thirds.

The fish is placed nape first, skin side up, on an inclined conveyor belt 18 inches wide which travels under two sprays and two cylindrical revolving brushes. It falls from this belt onto a second one - face up - and under sprays and brushes as on the first belt. It has washed heavily salted fish at the following rates during production, not on time trials.

Small (12 to 18 in.) - 2694 lb. per hour
Medium (18 to 23 in.) - 4494 lb. per hour
Large (above 23 in.) - 7120 lb. per hour

The rate for lightly salted fish is much the same. However, the face of this fish is merely sprayed as brushing tends to roughen it. Fish of this type that was soft before splitting is not handled by the machine readily or well. In fact, soft fish is costly to process all along the line and gives a poor quality end product.

It may be seen from the above figures that small fish are far more costly to work; this is true throughout the production picture - from splitting to packing.

It is felt that this washer can be further modified to make it a more compact and efficient machine. The machine can be decreased in length, improved mechanically and made more readily mobile so that it can be moved to the fish to be washed.

Plywood Pickle Tank. A small, prefabricated pickle tank was designed and built using four, 4 ft. by 8 ft. by $\frac{3}{4}$ in. sheets of Douglas Fir plywood. The tank was designed so that the component parts could be fabricated at a wood-working shop and shipped to the point of usage in a "knocked-down" package and there erected with a minimum of labour. Threaded steel tension rods are used to erect the tank rather than nails or screws. The tank is 4 ft. deep, 3 ft. 6 in. wide and 7 ft. 6 in. long and the component parts can be made for about $180 depending on locality and number required.

A tank of this type has been in use at Bonavista during the past season. No difficulty has been experienced in keeping it tight. It must, however, be levelled before use so as to avoid undue strains. The tank has been in use for too short a period to give any idea of its useful life.

Splitting Machines. One Baader header-splitter for the processing of salt fish was installed at the Experimental Salt Fish Plant at Bonavista in 1953, a second unit being added in 1954. During the 1953 season the machine turned out well-split fish and little difficulty was experienced after the initial adjustments were made. Break-downs were few and of a minor nature. While the economic advantage over hand splitting was rather indefinite the general excellence and uniformity of splitting made the machine most worthwhile.

The old machine did not perform as well in 1954 and the new machine began to miss also during the latter part of the season. There were frequent mechanical and electrical break-downs which, at times, interrupted production for rather long periods.

It is hoped to give both machines a complete over-haul during the off-season and to replace any worn parts. The Baader Company will be furnishing a complete parts list which will help greatly in making repairs.

General Engineering Services. The Technological Unit has received requests for designs, layouts, information and opinions on most all phases of the fresh and salt fish industries. The Unit recently completed plans and specifications for the Valleyfield salt fish experimental plant and for a small salt fish plant for the Newfoundland Fisheries Development Authority. Trips have been made to most fishing areas in Newfoundland by car, plane and ship for assessing existing facilities, for plant site selection and to confer, to give opinions, to inspect and to supervise installations. Engineers of the Unit, in conjunction with the Federal Department of Fisheries, made surveys of almost all fish plants in Newfoundland, preparatory to the drawing-up of minimum requirements and regulations for plants under the Federal Inspection plan. The Unit helped draw-up proposed plant specifications for Newfoundland.

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STAFF

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(To December 1, 1954)

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C. A. Rose	Assistant Tech. Grade 3
O. L. Elizabeth Scott, B.A.	Assistant Tech. Grade 3
R. F. Burfitt	Assistant Tech. Grade 2
M. S. Banfield	Assistant Tech. Grade 2 (from May 3)

J. Butt	Assistant Tech. Grade 2 (from May 3)
E. Frost	Assistant Tech. Grade 2 (resigned April 1)
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F. E. LeMessurier	Assistant Tech. Grade 2
H. R. Mullett	Assistant Tech. Grade 2
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H. G. Dawe	Assistant Tech. Grade 1 (from June 1)
L. A. Forward	Assistant Tech. Grade 1 (from October 1)
A. M. Oake	Assistant Tech. Grade 1 (resigned September 18)
A. T. Pinhorn	Assistant Tech. Grade 1 (resigned September 14)

Administrative and Clerical

O. E. Wheeler	Admin. Officer Grade 1
Sheila T. M. Keough	Stenographer Grade 2B
Ann M. House	Stenographer Grade 2A
Peggy I. Burry	Clerk Grade 2A
M. Louise Downton	Stenographer Grade 1 (from May 10)

M. V. Investigator II

Wm. Barbour	Captain (see Technical)
E. M. Mullett	Mate
C. R. Barbour	Chief Engineer
R. E. Inkpen	Second Engineer
G. S. Tippett	Cook
C. Roberts	Boatswain (resigned September 23)
C. Kean	Boatswain (from September 24)
A. Best	Twinehand
S. T. Inkpen	Twinehand (from March 25)
D. W. Mouland	Twinehand (from September 27)

M. V. Marinus

F. A. Winsor	Captain (see Technical)
E. C. Blackwood	Engineer
H. Freeborne	Cook (from March 26)
C. H. Andrews	Boatswain
L. Baker	Twinehand
M. Walbourne	Twinehand

M. B. Parr	
R. F. Burfitt	Skipper (see Technical)

Seasonal and Term

C. W. Andrews, Ph.D. (Toronto)	Assistant Scientist (June 1-September 3)
E. Lear, B.Sc. (Acadia)	Junior Scientist (May 20-September 15)
F. K. Spencer	Assistant Tech. Grade 3 (May 17-September 10)
J. G. Mullins	Assistant Tech. Grade 2 (May 10-August 27)
J. Barbour	Assistant Tech. Grade 1 (June 28-September 17)
W. J. Chaisson	Assistant Tech. Grade 1 (March 25-November 2)
V. Davidge	Assistant Tech. Grade 1 (April 2-October 21)
V. Dominic	Assistant Tech. Grade 1 (April 1-October 31)
L. Farrell	Assistant Tech. Grade 1 (April 1-October 31)
L. A. Forward	Assistant Tech. Grade 1 (June 28-September 30)
W. Hayward	Assistant Tech. Grade 1 (April 1-October 31)
Faith L. Hiscock	Assistant Tech. Grade 1 (May 17-September 10)
L. W. Hynes	Assistant Tech. Grade 1 (March 25-November 2)
Ann M. Munro	Student Assistant (May 17-September 3)

Total full time staff on December 1 was 54.

NEWFOUNDLAND TECHNOLOGICAL UNIT

Scientific

M. A. Foley, B.E. (Nova Scotia Tech.)	Senior Scientist
C. M. Blackwood, B.Sc. (Dalhousie)	Assistant Scientist (transferred May 20)
W. D. McDougall, B.E. (Nova Scotia Tech.)	Assistant Scientist (from January 4)
R. J. Noah, B.E. (Nova Scotia Tech.)	Assistant Scientist

Technical

T. P. Carew	Assistant Tech. Grade 2 (from October 1)

Clerical

M. J. Dinn	Stenographer Grade 2B

Seasonal

K. P. Barrett, B.Sc. (Dalhousie)	Student Assistant (May 10-September 15)

Total full time staff on December 1 was 5.

ORGANIZATION

Assignment of Staff by Project and Investigation for the period April 1 to December 1, 1954

1. Administrative

Director	W. Templeman, Ph.D.
Admin. Officer Grade 1	O. E. Wheeler
Stenographer Grade 2B	Sheila T. M. Keough
Stenographer Grade 2A	Ann M. House
Clerk Grade 2A	Peggy I. Burry
Stenographer Grade 1	M. Louise Downton

2. Groundfish Biology

Director	W. Templeman, Ph.D.
Assistant Tech. Grade 3	V. M. Hodder

3. Groundfish Population Studies

Associate Scientist	A. M. Fleming, M.A.
Assistant Scientist	B.G.H. Johnson, M.Sc.
Assistant Scientist	T. K. Pitt, B.Sc.
Assistant Tech. Grade 3	S. H. Butler
Assistant Tech. Grade 1	T. Collier
Assistant Tech. Grade 1	P. C. Collins
Assistant Tech. Grade 1	L. A. Forward

4. Longlining

Assistant Scientist	H. D. Macpherson, B.Sc.
Assistant Tech. Grade 3	L. N. Cluett
Assistant Tech. Grade 2	J. Butt
Assistant Tech. Grade 2	H. R. Mullett
Assistant Tech. Grade 3 - Term	F. K. Spencer
Assistant Tech. Grade 1 - Term	J. Barbour

5. Danish Seining and Witch Flounder

Assistant Scientist	T. N. Stewart, B.Sc.

6. Redfish Life History

Assistant Scientist	H. J. Squires, B.Sc.
Assistant Scientist	E. J. Sandeman, B.Sc.
Assistant Scientist	D. G. Lambert, B.A.

7. Savings Gear and American Plaice

Assistant Scientist	R. W. Ellis, B.Sc.

8. Technician Pool (Groundfish)

Technician Grade 1	C. I. Barbour
Assistant Tech. Grade 3	O. L. Elizabeth Scott, B.A.
Assistant Tech. Grade 2	E. M. LeGrow
Assistant Tech. Grade 2	F. E. LeMessurier
Assistant Tech. Grade 2	M. S. Banfield
Assistant Tech. Grade 2	Shirley J. Woolridge
Assistant Tech. Grade 1	H. G. Dawe
Assistant Tech. Grade 2 - Term	J. G. Mullins
Assistant Tech. Grade 1 - Term	Faith L. Hiscock
Student Assistant - Term	Ann M. Munro

9. M. V. Investigator II (Groundfish and Hydrography)

Technician Grade 2 - Captain	Wm. Barbour
Mate	E. M. Mullett
Chief Engineer	C. R. Barbour
Second Engineer	R. E. Inkpen
Cook	G. S. Tippett
Boatswain	C. Kean
Twinehand	A. Best
Twinehand	S. T. Inkpen
Twinehand	D. W. Mouland

10. M. V. Marinus (Groundfish and Hydrography)

Technician Grade 1 - Captain	F. A. Winsor
Engineer	E. C. Blackwood
Cook	H. Freeborne
Boatswain	C. H. Andrews
Twinehand	L. Baker
Twinehand	M. Walbourne

11. Atlantic Salmon - River Population Surveys

Senior Scientist	A. A. Blair, Ph.D.
Technician Grade 1	F. A. Day
Assistant Tech. Grade 3	A. P. Cowan
Assistant Tech. Grade 1 - Term	V. Dominic
Assistant Tech. Grade 1 - Term	L. Farrell
Assistant Tech. Grade 1 - Term	W. Hayward

12. Atlantic Salmon - River Population Study

Assistant Scientist	A. R. Murray, B.Sc.
Assistant Tech. Grade 2	R. F. Burfitt
Assistant Tech. Grade 1 - Term	W. J. Chaisson
Assistant Tech. Grade 1 - Term	V. Davidge
Assistant Tech. Grade 1 - Term	L. W. Hynes

13. M. B. Parr

Assistant Tech. Grade 2 - Skipper	R. F. Burfitt (assigned to River Population Study)

14. Marine Mammals

Assistant Scientist	D. E. Sergeant, Ph.D.
Assistant Tech. Grade 3	C. A. Rose

15. Arctic Char

Assistant Scientist - Term	C. W. Andrews, Ph.D.
Junior Scientist - Term	E. Lear, B.Sc.

16. Hydrography

Assistant Scientist - Part Time	Gertrude L. Andrews, B.Sc
Technician Grade 1	A. G. Kelland

17. Photographic and Laboratory Services

Technician Grade 1	E. L. Rowe

18. Technological Unit

Senior Scientist	M. A. Foley, B.E.
Assistant Scientist	R. J. Noah, B.E.
Assistant Scientist	W. D. McDougall, B.E.
Assistant Tech. Grade 2	T. P. Carew
Student Assistant - Seasonal	K. P. Barrett, B.Sc.
Stenographer Grade 2B	M. J. Dinn

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CAPE CHIDLEY

RAMAH

HEBRON

OKAK

NAIN

ADLATOK

LABRADOR

HAMILTON INLET BANK

DOMINO

HAWKES HR.

BATTLE HR.

ST. ANTHONY

STRAIT OF BELLE ISLE

QUEBEC

PORT AU CHOIX

WHITE BAY

LA SCIE

TWILLINGATE

FUNK IS.

BADGERS QUAY

BONAVISTA

TRINITY

ANTICOSTI IS.

BAY OF ISLANDS

GULF OF ST. LAWRENCE

ST. GEORGES BAY

NEWFOUNDLAND

BAY DU NORD R.

ORPHAN BANK

LIT. CODROY R.

GAULTOIS

PORT AUX BASQUES

RAMEA

DILDO

ST. JOHN'S

BRADELLE BANK

CABOT STRAIT

FORTUNE

BURIN

MIQUELON IS.

ST. MARYS

TREPASSEY

FLEMISH CAP

CHETICAMP

P.E.I.

NOVA SCOTIA

ST. PIERRE BANK

GREEN BANK

GRAND BANK

BANQUEREAU

S.E. SHOAL

SABLE IS. BANK

COASTLINE

30 FMS.

50 FMS.

100 FMS.

200 FMS.

1000 FMS.

Appendix No. 1

Redfish - Hermitage Bay

In addition to the exploratory fishing and various experimental trips carried out by the "Investigator II" during the past 10 months, the "Marinus" has made 3 visits to Hermitage Bay. It was hoped that by concentrating on the one area throughout 12 months or longer, a large volume of useful data would be obtained, particularly with regard to the cyclical aspects of redfish biology.

An interesting situation with regard to possible large or small scale horizontal movements of the adult redfish population is evident from these frequent trips to the one small area. Marked differences in catches were found between the trip in December, 1953, and the trips in June and September, 1954. The average catch per 30-minute drag in December, 1953, was only 86 lb., whereas in the latter two trips average catches of 1726 and 2000 lb. per 30-minute drag were obtained respectively. Examination of the length measurements shows this difference to be due mainly to the relative presence or absence of the larger fish: 59% and 65% of the fish caught during June and September respectively were over 30 cm. in length and in December, 1953, only 19% were in this category.

Hermitage Bay, and to an even greater extent the adjacent Connaigre Bay, have the additional advantage that relatively large numbers of small recently-settled redfish are present, as well as a large population of adults. A dominant length group of 7 cm., age (scale) 0+, was found in December 1953. This group is well separated from age groups above it and by following its progress much concrete information should be obtained.

E. J. Sandeman

Appendix No. 2

Age and Growth of Redfish

This aspect of the investigation has for the most part been concerned with attempting to gain some understanding of the central zone of the otolith, and with correlating "scale" ages with "otolith" ages. In this connection, some time in the field has been spent in search of small presettled pelagic redfish. The results in this respect have been disappointing as only two such fish have been caught to date.

E. J. Sandeman

Appendix No. 3

Feeding of Redfish

The analysis of redfish stomach contents was continued this year and to date 2700 stomachs have been examined. Of this number 20% contained food, 50% were empty and 30% were everted and the contents, if any, lost. The main food organisms found were the euphausians Meganyctiphanes norvegica, Thysanoessa raschii and Thysanoessa inermis; the hyperiid amphipods, Themisto libellula and Themisto gaudichaudi and the copepods Calanus finmarchicus and Calanus hyperboreus.

Considering all the samples together, 54% contained hyperiid amphipods, 49% contained copepods, 44% contained euphausians and 10% fish. Of the total volume of food consumed, 36% consisted of hyperiid amphipods, 22% of fish, 20% of euphausians and 16% of copepods, the remaining portion consisting of shrimp, squid, pteropod molluscs and chaetognaths. There is a change in diet related to the increase in size of the fish. The larger fish are feeding to a much greater extent on other fish and to a lesser extent on euphausians and copepods, while amphipods still form quite a large part of their diet. This is illustrated by the following Table.

Percentage of Total Volume of Food Contributed by Each Food Group

Length cm.	Fish	Euphausians	Amphipods	Copepods	Others
Below 26 cm.	0	53	24	13	10
26-30 cm.	1	12	63	19	5
31-35 cm.	11	11	50	20	8
36-40 cm.	18	28	28	19	7
Above 40 cm.	54	8	29	6	3

There is also a difference in the feeding habits of fish from different areas. On the southwest edge of the Grand Bank, fish and euphausians are the most important food organisms but on the northern part of the bank and off Hamilton Inlet Bank, amphipods and copepods form the major part of the diet with a smaller amount of fish. In Hermitage Bay, euphausians are present in the stomachs in very large quantities to the exclusion of

almost all the other groups, while in the Gulf of St. Lawrence, shrimp are the most important food group with smaller numbers of euphausians.

Percentage of Total Volume of Food Contributed by Different Food Groups

Area	Fish	Euphausians	Amphipods	Copepods	Shrimp	Others
Southwest Edge of Grand Bank	62.0	34.0	3.0	0.3	-	0.7
Northern Grand Bank and Hamilton Inlet Bank	14.0	1.0	56.0	26.0	-	3.0
Hermitage Bay	4.0	87.0	0.1	1.0	-	7.9
Gulf of St. Lawrence	-	33.0	4.0	8.0	46.0	9.0

The problem of the eversion of the stomach and the loss of its contents as the fish are brought up in the trawl has been further considered. More figures are available now and a total of 3926 fish has been examined. The following Table shows the results obtained by relating the percentage eversion firstly to depth and secondly to the size of the fish concerned. There is no doubt that depth is the major factor involved but it also appears that the smaller fish are more likely to suffer from the effects of the pressure change than the larger ones.

Redfish Stomach Eversion

Depth fm.	Total number of fish				% everted				Total all sizes	% everted all sizes
	Below 20 cm.	21-30 cm.	31-35 cm.	Above 35 cm.	Below 20 cm.	21-30 cm.	31-35 cm.	Above 35 cm.		
100 - 149	418	309	158	269	60	24	10	7	1154	30
150 - 200	70	880	603	653	31	40	26	18	2206	30
201 - 300	-	80	107	284	-	44	29	45	471	41
300 - 390	-	3	78	14	-	66	61	43	95	60
Total and % everted all depths	488	1272	946	1220	57	36	27	21	3926	32

D. G. Lambert

Appendix No. 4

Examination of Redfish Gonads for Maturity Tests and Evidence of Sperm Storage

Small male redfish whose gonads, on gross examination, appeared immature have been examined for the presence of mature spermatozoa.

It was found that the width of the testis gives a reasonably accurate guide to the stage of maturity of these small fish. If the testis is greater than 1.5 mm. in width, it will contain sperm and can be considered as maturing; it may not be fully mature but the gonads are functioning in sperm production. In the case of the smaller fish, this probably indicates that they are approaching first maturity but in larger fish it possibly means that the gonads have returned to a stage which has an immature appearance. This reversion may continue for the first few years of maturity.

Samples of redfish gonads (male and female from the same set), collected and preserved at sea as well as in the laboratory, were examined to check the maturity of the males and to find any evidence of sperm storage in either males or females. The samples were taken throughout the year, mainly from the southwest and eastern edges of the Grand Bank but also from Hamilton Inlet Bank, Hermitage, Fortune and Trinity Bays and Misaine Bank.

During the maturity tests in the males it has been shown that after first maturity, spermatozoa can be found in quantity in the testes throughout the year and there does not appear to be a definite resting phase in their production. No evidence of sperm storage in either males or females was found. In the males, the testis, vas deferens and "sac" were examined and in the females, the ovary, oviducts and "sac". Occasional isolated spermatozoa were found in the male sac but never more than 10 per smear. These most likely enter the sac by chance during the emission of the sperm. In one sample, the males were completely ripe and sperm was found in large amounts in the penis itself but there was none in the sacs. Neither in this sample nor in any others was there evidence of sperm in the female sac, ovary or oviducts.

Dissections of the urinogenital systems of males and females have shown that the sac is probably a functional urinary bladder and not an organ of sperm storage.

D. G. Lambert

AMERICAN PLAICE

Appendix No. 5

Preliminary Notes on the Migration of American Plaice

The main commercial fishery for plaice occurs on the northern and eastern slopes of the Grand Bank. Here almost all the fish are over 40 cm. in length and over 10 years of age. Of the areas studied, only St. Mary's Bay has yielded large numbers of younger fish less than 40 cm. Plaice from the northern Grand Bank are smaller, on the whole, than those from the eastern edge.

From the above evidence and data on the otolith structure, the following preliminary hypothesis of migration behaviour has been prepared. The plaice grow up in the nursery grounds in or near St. Mary's Bay and on approaching sexual maturity at the age of 10-12 years, migrate first to the north and east, picking up recruits as they go round the edge of the Grand Bank in a clockwise drift. As they approach the southeast corner of the bank they are "trapped" in a pocket. The water to the south and east is too deep (i.e. is off the bank) and to the west is too warm. The plaice may tend then to wander at random over the grounds of the eastern edge, congregating in larger shoals where either the ground or water temperature is suitable.

Tagging experiments have been carried out this year in St. Mary's Bay and on the northern Grand Bank to test the migration hypothesis outlined above.

R. S. Keir

Appendix No. 6

Estimate of the Total Weight of Available Stock of Plaice on the Eastern and Northern Edges of the Grand Banks

The total area concerned is about 13,500 square miles. This includes a large area (about 4,000 sq. mi.) of the northeast Grand Banks which has not been explored by commercial draggers.

If an estimate of the area covered by a trawl effectively in an hour's drag is taken as 1/25 (0.04) sq. mi.; and if a catch of 2,000 lb. per hour's dragging is taken as an average for this whole area;

Then the TOTAL WEIGHT OF AVAILABLE PLAICE STOCK = 13,500 x 25 x 2,000 lb.
= 675,000,000 lb.

The limits may be taken as approximately half to one and a half times this figure, i.e. from 337,500,000 - 1,012,500,000 lb.

The present yield from this fishery is not more than 30,000,000 lb., i.e. at the most 8.9% of the available stock. Probably it is nearer 5%. However this is from a virgin stock which - in the absence of fishing - has been permitted to accumulate, and fishing at the present rate (i.e. approx. 30,000,000 lb. per year) will reduce the stock and an increasing effort will be required in future years to maintain this yield until an equilibrium is reached. Conversely, if the fishing effort remains constant, the total yield will fall until a yield is reached which will be the average equilibrium yield for the present fishing effort. If the figure 675,000,000 lb. is accepted as the present available stock, then the initial available stock would have been somewhat greater - say 800,000,000 lb.

This figure can then be compared with the 11,580 arbitrary units of weight of the initial stock in the population study. The present yield (30,000,000 lb.) represents 3/80 (30,000,000/800,000,000) of the initial available stock, i.e. 3/80 of 11,580 arbitrary units of weight or about 434 arbitrary units.

This yield is considerably less than the approximate maximum sustained yield of 670 arbitrary units.

The Theoretical Maximum Sustained Yield $\frac{670}{434}$ x 30,000,000 lb.

46,000,000 lb. (approx.)

This yield will be obtained by a fishing intensity of about 20-30%. The lower figure represents about four times the present effort. Hence when this fishing intensity is reached, the catch per boat (fishing with the same effort and efficiency as this year) will fall to

$\frac{46,000,000}{4 \times 30,000,000}$ or 38% of the present catch per boat.

This is probably a high estimate; however, it does not take into account any increase in growth rate resulting from the reduced stock density.

R. S. Keir

Appendix No. 7

American Plaice Population Study

While the plaice of the Grand Banks may belong to one population, this study applies particularly to the plaice of the eastern edge where the data were collected.

In a population study it is most desirable to have a table showing the frequency of different year classes; ideally this should be obtained by reading a very large number of otoliths taken from random samples of the population.

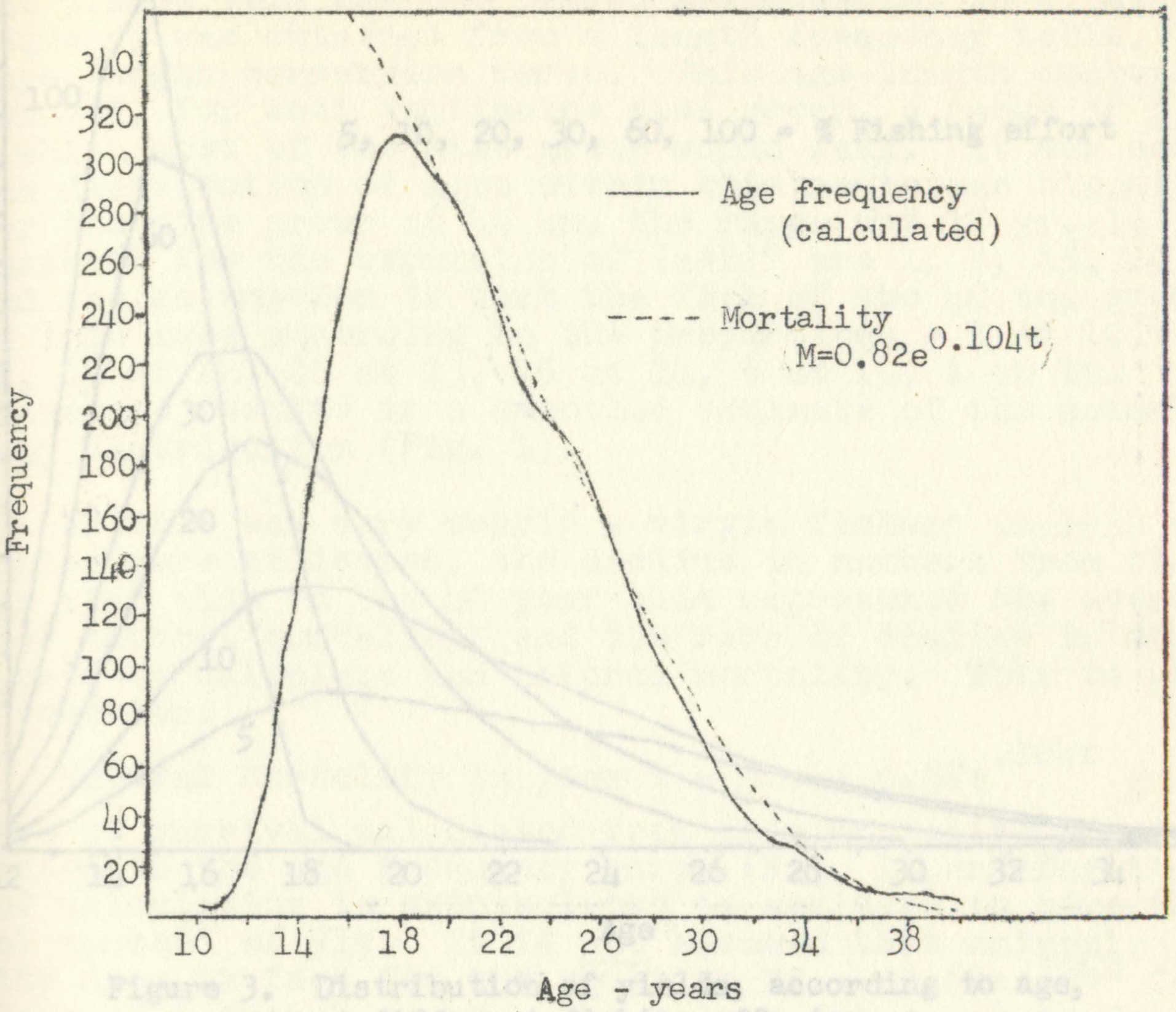


Figure 1.

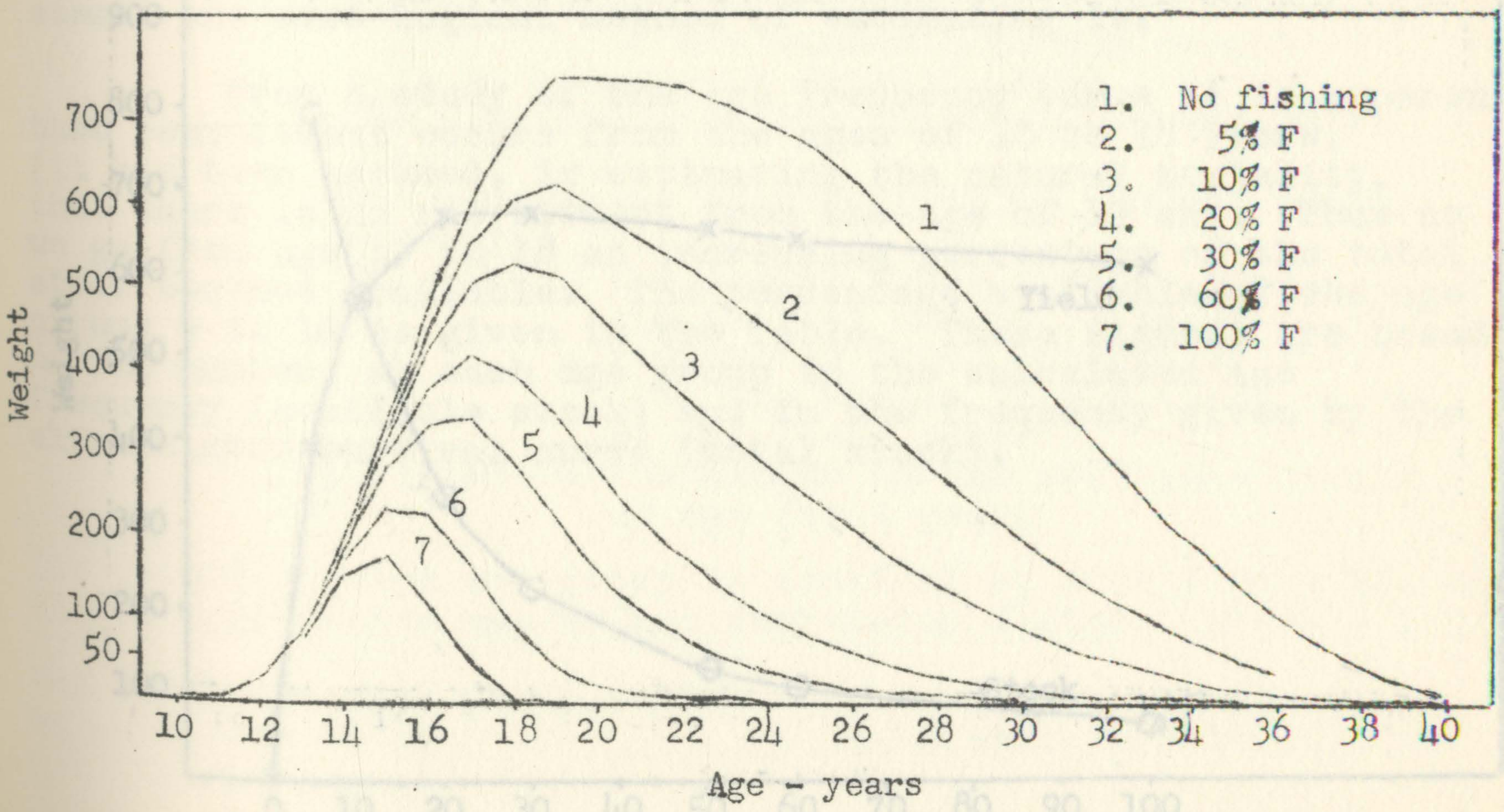


Figure 2. Available stocks

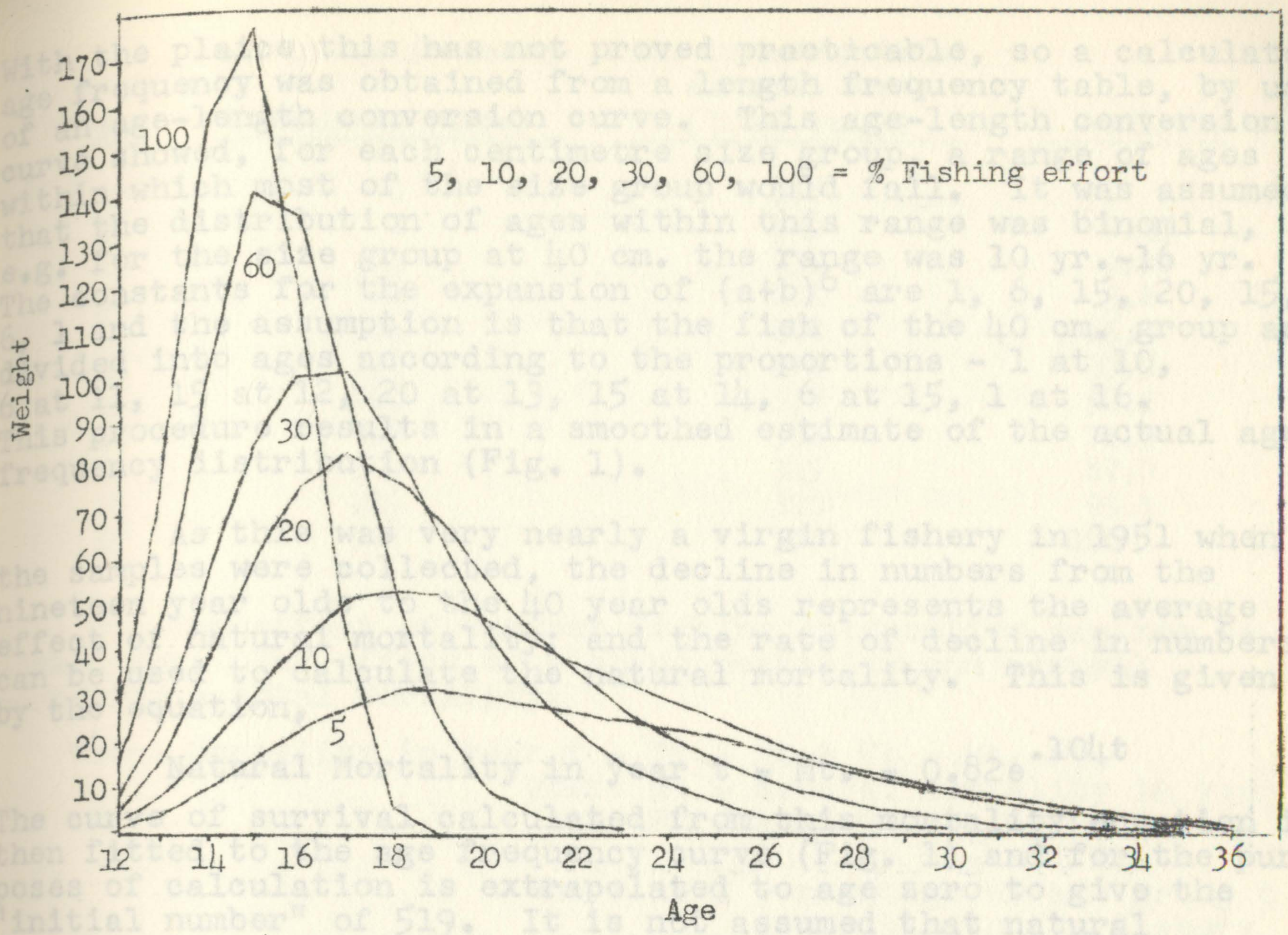


Figure 3. Distribution of yields, according to age, at different fishing efforts

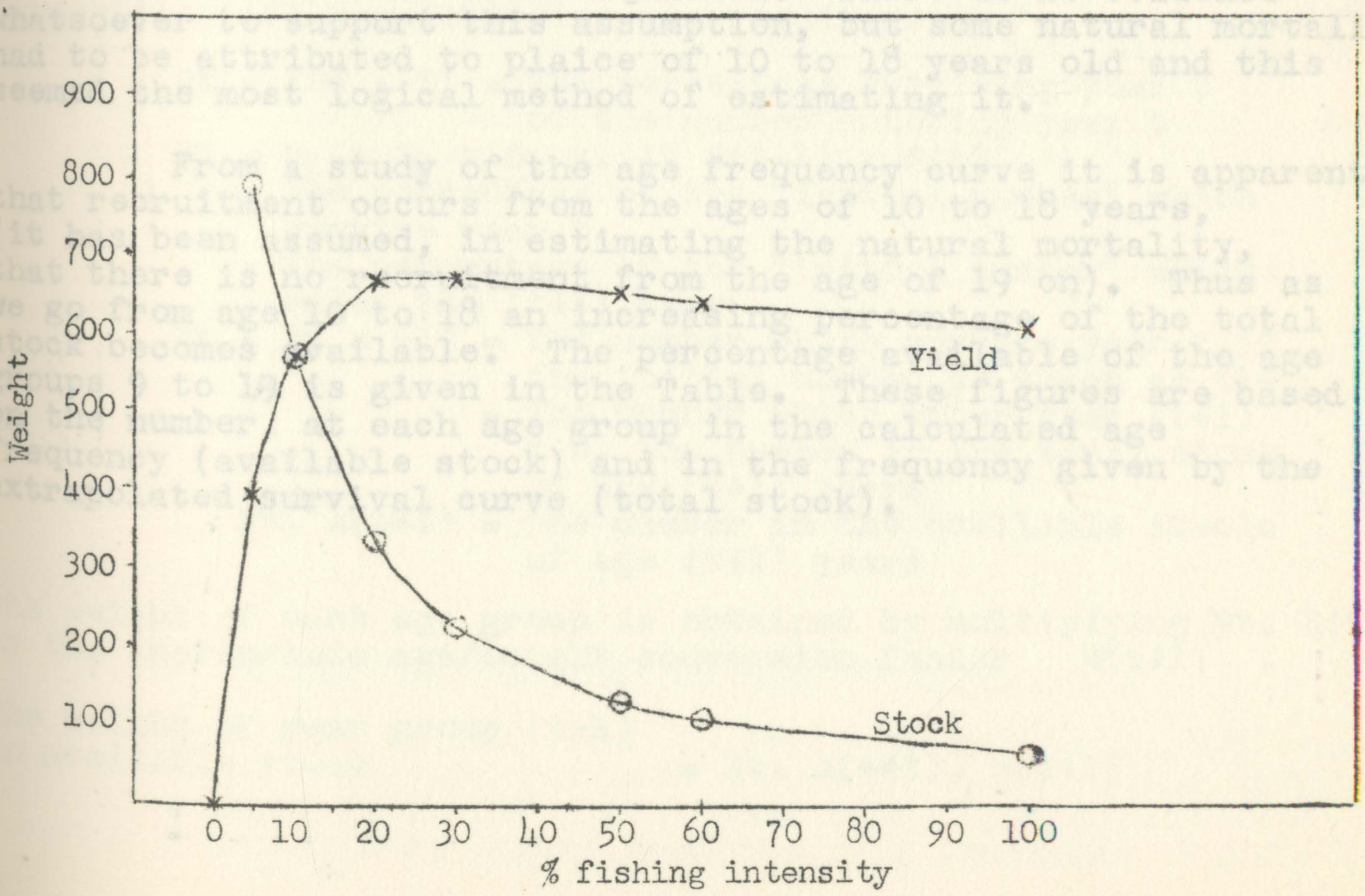


Figure 4. Yield and available stock/fishing intensity (F.)

With the plaice this has not proved practicable, so a calculated age frequency was obtained from a length frequency table, by use of an age-length conversion curve. This age-length conversion curve showed, for each centimetre size group, a range of ages within which most of the size group would fall. It was assumed that the distribution of ages within this range was binomial, e.g. for the size group at 40 cm. the range was 10 yr.-16 yr. The constants for the expansion of $(a+b)^6$ are 1, 6, 15, 20, 15, 6, 1 and the assumption is that the fish of the 40 cm. group are divided into ages according to the proportions - 1 at 10, 6 at 11, 15 at 12, 20 at 13, 15 at 14, 6 at 15, 1 at 16. This procedure results in a smoothed estimate of the actual age frequency distribution (Fig. 1).

As this was very nearly a virgin fishery in 1951 when the samples were collected, the decline in numbers from the nineteen year olds to the 40 year olds represents the average effect of natural mortality; and the rate of decline in numbers can be used to calculate the natural mortality. This is given by the equation,

$$\text{Natural Mortality in year } t = Mt. = 0.82e^{.104t}$$

The curve of survival calculated from this mortality equation is then fitted to the age frequency curve (Fig. 1) and for the purposes of calculation is extrapolated to age zero to give the "initial number" of 519. It is <u>not</u> assumed that natural mortality does in fact fit the equation $Mt. = 0.82e^{.104t}$ for all values of t from 1 to 40. The values for t = 1 to 9 are used for convenience only in the following calculations. Their use does not imply that the initial number was in fact 519. However it is assumed that the natural mortality for ages 10 to 18 does fit the above equation. There is no evidence whatsoever to support this assumption, but some natural mortality had to be attributed to plaice of 10 to 18 years old and this seemed the most logical method of estimating it.

From a study of the age frequency curve it is apparent that recruitment occurs from the ages of 10 to 18 years, (it has been assumed, in estimating the natural mortality, that there is no recruitment from the age of 19 on). Thus as we go from age 10 to 18 an increasing percentage of the total stock becomes available. The percentage available of the age groups 9 to 19 is given in the Table. These figures are based on the number at each age group in the calculated age frequency (available stock) and in the frequency given by the extrapolated survival curve (total stock).

Age	No. in age frequency (Available stock)	No. in extrapolated survival curve (Total stock)	% available
9	0	456	0
10	2	445	0.45
11	4	434	0.92
12	22	421	5.2
13	64	408	15.7
14	132	394	33.5
15	200	378	52.9
16	258	362	71.3
17	300	345	87.0
18	310	326	95.1
19	307	307	100

The effect of various fishing intensities can now be worked out. The effect of fishing mortality and natural mortality = total mortality.

Total Mortality in year t = Tt = Mt + Ft - Mt. Ft.
Where Mt = natural mortality in year t
and Ft = actual fishing mortality in year t = At. F.
Where At = percentage of age group t available to the fishery
and F = fishing intensity

Any change in the growth rate or behaviour of the plaice caused by fishing has <u>not</u> been taken into account.

To calculate the stocks and yields for various fishing intensities (F) the following are required.

St = 100 - Tt = The percentage surviving year t of the number entering year t
Pt = $S_1 \times S_2 \times S_3 \times \ldots \times S(t-1) \times S(t)$
= The percentage of the "initial number" which survive year t
= The percentage of the "initial number" which enter the (t+1) year
Nt = Pt x 519 = The number which survive year t if the initial number is taken as 519
= The number which enter year (t+1) i.e. the number in the total stock of age (t+1) years
Nt. A(t+1) = The number in the available stocks of age (t+1) years

The weight of each age group is obtained by multiplying Nt. A(t+1) by the appropriate age/weight conversion factor W(t+1) .

The weight of year group (t-1) in available stock = Nt. A(t+1). W(t+1)

$$\text{The weight of available stock (all year groups)} = \sum_{t=40}^{t=9} Nt.\ A(t+1).\ W(t+1)$$

$$\text{The weight of the yield (all age groups)} = \sum_{t=40}^{t=9} Nt.\ A(t+1).\ W(t+1) \times F$$

The "weight at age" distribution of the available stocks and yields for fishing intensities of 5, 10, 20, 30, 60 and 100% are shown in Figures 2 and 3. The "weight at age" distribution for the initial available stock is also shown, i.e. the available stock before fishing commenced.

The weights of the available stocks and yields are plotted against fishing intensity in Figure 4.

Figure 4 clearly shows the rise in yield to a maximum at a fishing intensity between 20-30%. With increased effort thereafter the yield falls slightly. There is therefore no point in increasing the fishing intensity over 20%.

The weight at age curves for the yields (Fig. 2) show that at 20% fishing intensity the yield has a mode at 17 years and that the greater part of the catch is between 14 and 25 years, i.e. between 42 and 54 cm. The average weight of a fish is about 2 lb. There is a relatively small part of the catch over 27 years, the approximate age at which the jellied condition may become a nuisance. While fishing at higher intensities would reduce the incidence of jellied condition still more, this probably would not prove economical. Fishing a slightly smaller size of plaice, i.e. reducing the recruitment age would also tend to eliminate the older (potentially jellied) fish. This seems likely to happen with the development of the fishery on the northern part of the Grand Banks, where the recruitment age is slightly lower. However the reduction in size of the stock by fishing may increase the amount of food available and in that way reduce the incidence of jellied condition if it is indeed a product of malnutrition.

R. S. Keir

GROUNDFISH CATCH AND EFFORT

Appendix No. 8

Groundfish Landings in Newfoundland, 1953

Landings of groundfish in Newfoundland during 1953 were below those of 1952. Of the most important species, cod, redfish and plaice landings in 1953 were lower while haddock and witch flounder landings were higher than the 1952 landings. (Table I).

Table I

Groundfish Landings (Thousands of Pounds Round Weight), Newfoundland 1952 and 1953

	ICNAF subareas							
	2		3		4		Total	
	1952	1953	1952	1953	1952	1953	1952	1953
Cod	36,821	24,438	407,055	354,114	38,851	38,312	482,726	416,865
Haddock			10,353	16,682	-	103	10,353	16,785
Pollock			506	27	-	-	506	27
Halibut			287	336	61	81	348	417
Wolffish			338	398			338	398
Redfish			27,682	22,880	3,500	6,035	31,182	28,914
Plaice			16,323	15,452		18	16,323	15,470
Witch			2,619	6,797		90	2,619	6,887

N.B. Apparent irregularities in totals are due to the rounding off to thousands

Table II

Otter Trawlers Operating from Newfoundland Ports (Number, Crew and Gross Tonnage)

	0-50 gross tons			51-150 gross tons			151-400 gross tons			Total		
	No. men	No. ships	Total g.tons	No. men	No. ships	Total g.tons	No. men	No. ships	Total g.tons	No. men	No. ships	Total g.tons
1945				12	1	126				12	1	126
1946				12	1	126				12	1	126
1947				21	2	206	28	2	312	49	4	518
1948				21	2	206	95	6	1484	116	8	1690
1949				21	2	206	153	10	2142	174	12	2348
1950				31	3	304	153	10	2142	184	13	2446
1951				31	3	304	210	13	3203	241	16	3507
1952				43	4	441	258	16	3760	301	20	4201
1953	5	1	33	43	4	441	360	22	5329	408	27	5803

Cod, as usual, made up the bulk of the landings, consisting of about 85% of the total. The majority of this was landed by the small inshore open boats fishing with cod traps, handlines and line trawls, and by longliners. Landings from this source in 1953 were only about 86% of the 1952 landings. In 1953 the fishery using cod trap was extremely poor in many sections of the coast.

The haddock catch of 1953 was considerably above those of the previous two years. For the first five months of the year the main effort was concentrated on haddock with about 80% of the year's total being landed. Fish of the 1946 year-class which were in the majority below commercial size in 1952 were large enough in 1953 to satisfy commercial requirements and so were retained in larger numbers than in 1952. In November and December a new practice was begun, that of landing small haddock in an ungutted condition; these had previously been rejected as undersized. This increased the landings by nearly three million pounds.

Witch flounder landings were far above the 1952 landings. On the Grand Bank this species is taken on the same grounds as the haddock and with the concentrated effort on haddock for about 8 months by the otter-trawlers, the catch of witch was comparatively high. In addition, the landings of witch by Danish seiners from the Fortune Bay grounds were about three times the 1952 landings.

With the majority of the effort concentrated for so long a period on haddock and greysole, the landings of plaice and redfish are below the 1952 landings for these species.

Halibut, wolffish and other less important groundfish landings remain at a low level since no great effort is expended towards their catch.

The number of otter-trawlers continued to increase, with 6 being added during 1953. (Table II). The Danish seiners increased from 2 to 7, though these were not in constant operation. The number of longliners fishing inshore grounds continued to increase, several new boats being added. There was, however, a decrease in the number of the smaller inshore boats. Fishery by dory schooners from Newfoundland has ceased, with no vessel regularly landing in Newfoundland in 1953.

Though it is difficult to assess the affect of economic factors on the fishery, it is known that incentive was down somewhat because of uncertain market conditions, high cost of fishing supplies and availability of employment outside the fishing industry.

A. M. Fleming

Appendix No. 9

Haddock Discarded at Sea, 1954

Up to the end of September the average percentages by weight of haddock caught and discarded at sea by three trawlers landing their catches in Newfoundland were about 27, 32, and 49 respectively, based on the captains' estimates. The overall average for the three was about 34% as compared with 55% in 1953. These estimates, though probably somewhat high, are fairly reliable, as comparisons with measurements by Station observers have indicated.

Percentages of Haddock Caught and Discarded

	Station measurements		Captains' estimates
	Numbers	Weight	Weight
1949	59	27	-
1950	52	33	-
1951	-	-	46
1952	18	9	9
1953	71	42	55
1954 (to end Sept.)	-	-	34

Percentages of haddock discarded at sea are high in years when fish of a new abundant year-class have reached a length permitting large numbers of them to be caught by the otter trawls, while still being undersized as far as market requirements are concerned. Thus, in 1951, the majority of the small fish discarded were of the 1946 year-class. In 1952, most fish of this year-class were large enough in size to be retained and the percentages discarded were correspondingly low. In 1953, the abundant 1949 year-class was being caught and discarded in large numbers. In 1954, undoubtedly as large amounts of this year-class as in 1953 would have been discarded but for a new development in the area, begun late in 1953, that of landing small haddock in ungutted condition for commercial use.

B.G.H. Johnson

Appendix No. 10

Landings of Small Haddock in Ungutted Condition

Up to late in 1953, commercial requirements were such that haddock less than about 45 cm. (18 in.) in length were discarded as unsuitable for filleting. However, when the extreme scarcity of larger haddock on the grounds became apparent late in 1953 and in the present year, local plants began accepting quantities of the smaller haddock (33-43 cm. or 13-17 in. in length), generally in an ungutted condition.

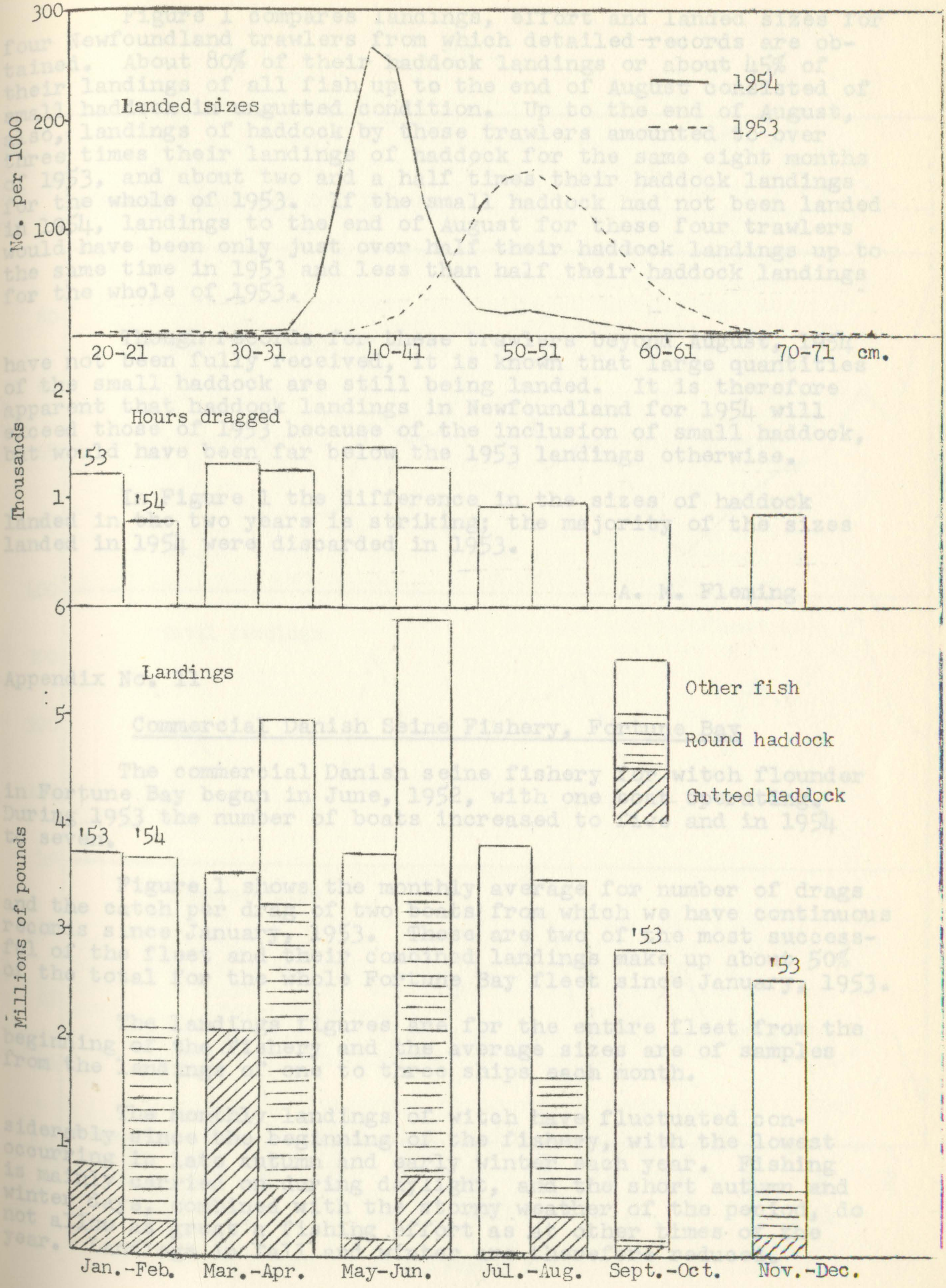

Landed sizes
No. per 1000
300
200
100
1954
1953
20-21
30-31
40-41
50-51
60-61
70-71 cm.
Hours dragged
Thousands
2
1
6
'53
'54
Landings
5
4
3
2
1
Millions of pounds
Other fish
Round haddock
Gutted haddock
'53 '54
'53
'53
Jan.-Feb.
Mar.-Apr.
May-Jun.
Jul.-Aug.
Sept.-Oct.
Nov.-Dec.

Figure 1.

Figure 1 compares landings, effort and landed sizes for four Newfoundland trawlers from which detailed records are obtained. About 80% of their haddock landings or about 45% of their landings of all fish up to the end of August consisted of small haddock in ungutted condition. Up to the end of August, also, landings of haddock by these trawlers amounted to over three times their landings of haddock for the same eight months of 1953, and about two and a half times their haddock landings for the whole of 1953. If the small haddock had not been landed in 1954, landings to the end of August for these four trawlers would have been only just over half their haddock landings up to the same time in 1953 and less than half their haddock landings for the whole of 1953.

Though records for these trawlers beyond August, 1954 have not been fully received, it is known that large quantities of the small haddock are still being landed. It is therefore apparent that haddock landings in Newfoundland for 1954 will exceed those of 1953 because of the inclusion of small haddock, but would have been far below the 1953 landings otherwise.

In Figure 1 the difference in the sizes of haddock landed in the two years is striking; the majority of the sizes landed in 1954 were discarded in 1953.

A. M. Fleming

Appendix No. 11

Commercial Danish Seine Fishery, Fortune Bay

The commercial Danish seine fishery for witch flounder in Fortune Bay began in June, 1952, with one boat operating. During 1953 the number of boats increased to five and in 1954 to seven.

Figure 1 shows the monthly average for number of drags and the catch per drag of two boats from which we have continuous records since January, 1953. These are two of the most successful of the fleet and their combined landings make up about 50% of the total for the whole Fortune Bay fleet since January, 1953.

The landings figures are for the entire fleet from the beginning of the fishery and the average sizes are of samples from the landings of one to three ships each month.

The monthly landings of witch have fluctuated considerably since the beginning of the fishery, with the lowest occurring in late autumn and early winter each year. Fishing is mainly carried on during daylight, and the short autumn and winter days, combined with the stormy weather of the period, do not allow as great a fishing effort as at other times of the year. Landings in fall and winter are therefore reduced.

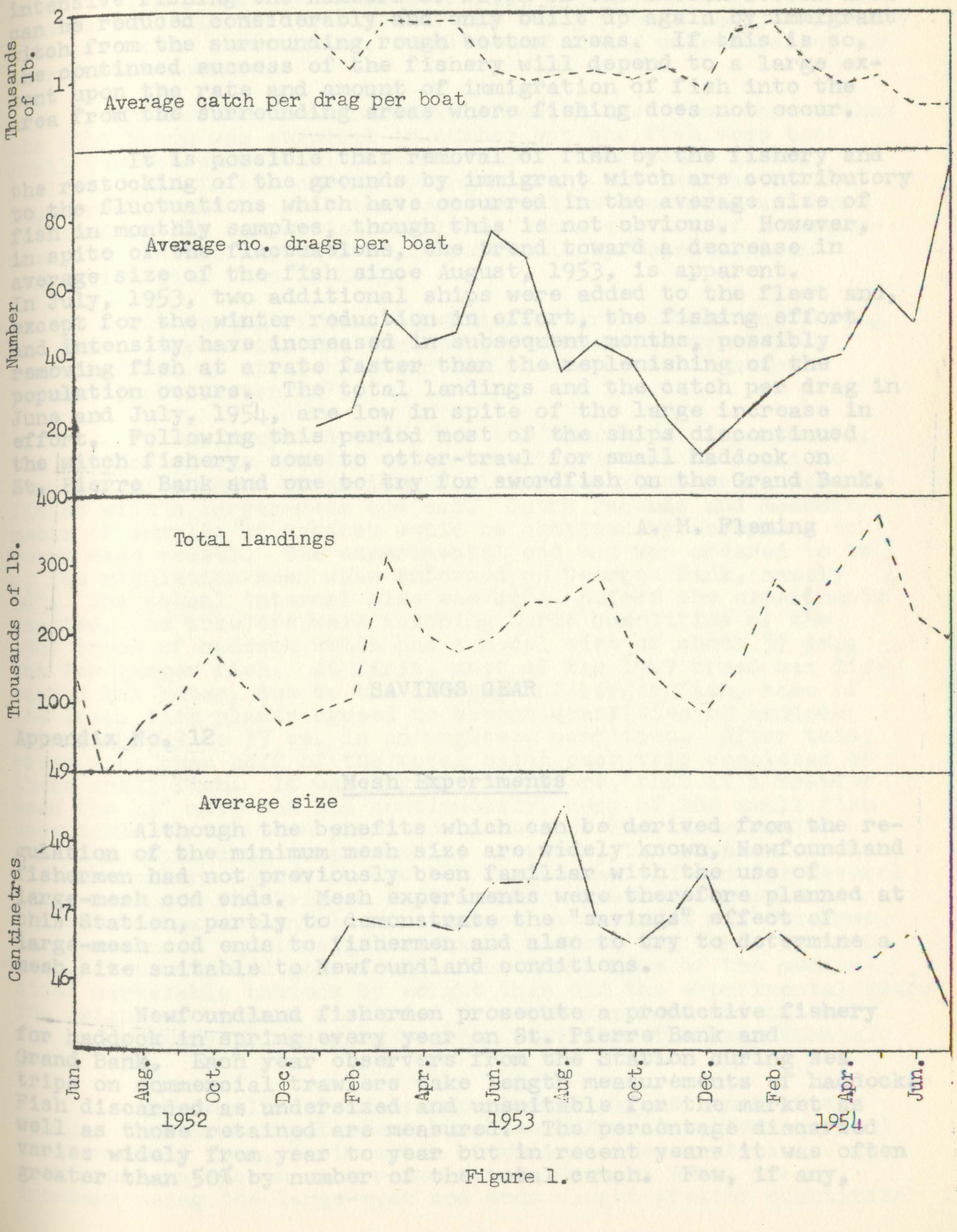

Average catch per drag per boat
Thousands of lb.
2
1
Average no. drags per boat
Number
80
60
40
20
Total landings
Thousands of lb.
400
300
200
100
0
Average size
Centimetres
48
47
46
Jun.
Aug.
Oct.
Dec.
Feb.
Apr.
Jun.
Aug.
Oct.
Dec.
Feb.
Apr.
Jun.
1952
1953
1954

Figure 1.

The smooth bottom area in Fortune Bay, where the main Danish seine fishery occurs, is quite small. Surrounding it is rougher bottom unsuitable for seining. It is possible that with intensive fishing the numbers of witch on the smooth bottom area can be reduced considerably and only built up again by immigrant witch from the surrounding rough bottom areas. If this is so, the continued success of the fishery will depend to a large extent upon the rate and amount of immigration of fish into the area from the surrounding areas where fishing does not occur.

It is possible that removal of fish by the fishery and the restocking of the grounds by immigrant witch are contributory to the fluctuations which have occurred in the average size of fish in monthly samples, though this is not obvious. However, in spite of the fluctuations, the trend toward a decrease in average size of the fish since August, 1953, is apparent. In July, 1953, two additional ships were added to the fleet and, except for the winter reduction in effort, the fishing effort and intensity have increased in subsequent months, possibly removing fish at a rate faster than the replenishing of the population occurs. The total landings and the catch per drag in June and July, 1954, are low in spite of the large increase in effort. Following this period most of the ships discontinued the witch fishery, some to otter-trawl for small haddock on St. Pierre Bank and one to try for swordfish on the Grand Bank.

A. M. Fleming

SAVINGS GEAR

Appendix No. 12

Mesh Experiments

Although the benefits which can be derived from the regulation of the minimum mesh size are widely known, Newfoundland fishermen had not previously been familiar with the use of large-mesh cod ends. Mesh experiments were therefore planned at this Station, partly to demonstrate the "savings" effect of large-mesh cod ends to fishermen and also to try to determine a mesh size suitable to Newfoundland conditions.

Newfoundland fishermen prosecute a productive fishery for haddock in spring every year on St. Pierre Bank and Grand Bank. Each year observers from the Station during sea trips on commercial trawlers take length measurements of haddock. Fish discarded as undersized and unsuitable for the market as well as those retained are measured. The percentage discarded varies widely from year to year but in recent years it was often greater than 50% by number of the total catch. Few, if any,

of these fish will survive when returned to the sea. Clearly the use of the existing gear results in a considerable wastage to the stock and of time to the fishermen when sorting on board. Prior to 1954, the Newfoundland market requirements of sizes of haddock were similar to those of the Georges Bank haddock fishery, fish less than about 45 cm. total length being unacceptable, and therefore discarded.

Measurements of haddock collected last year showed that the 1949 brood was abundant in number but the fish were too small for the commercial fishery. Early this year, it was realised that in the coming spring fishery the lengths of the 1949 brood would be such that some would be discarded and some retained by the commercial trawlers. Thus the use of a larger-mesh cod end was expected to be particularly beneficial in connection with this fishery.

Two series of mesh experiments were carried out during the year. One series was done on two commercial trawlers operating out of St. John's and the second on the research vessel "Investigator II".

It was proposed that, for the commercial experiments, the catches of one trawler using her standard trawl would be compared with those of an identical trawler whose trawl was fitted with a larger-mesh cod end. Catch records and measurements of samples of haddock would be obtained by observers on board each vessel. The experimental cod end was ordered to be of the regulation mesh size enforced on Georges Bank, namely $4\frac{1}{2}$". The actual internal size was $4\frac{1}{4}$". Before the experiments started, the trawlers were catching large quantities of the 1949 brood of haddock which had a modal size of about 39 cm., but few larger fish. At first, most of the 1949 brood was discarded but later, due to the shortage of larger fish, some of the local fish plants agreed to accept quantities of haddock from about 43 to 33 cm. in an ungutted condition. After this, often more than half of the total catch each trip consisted of these small fish. It was likely, therefore, that if a trawler used the $4\frac{1}{4}$" mesh cod end continuously, many of the small fish acceptable to the fish plant would be lost and the vessel's earnings might drop considerably. However, the captain of one of the trawlers agreed to use the large-mesh cod end for several hauls during a few trips. Only a small number of comparisons between the experimental and standard net catches was obtained. An approximate equal weight of large haddock was taken by each gear. The standard gear caught four times more of the medium-sized marketable haddock by weight than did the experimental gear. The weight of haddock discarded from the standard net catches was about twelve times greater than that from the experimental gear.

The results of these experiments suggest that if the Georges Bank mesh regulations had been enforced on Newfoundland trawlers this year, their catch of medium-sized marketable haddock would have been much reduced. On Georges Bank, the trawlers using the large-mesh cod ends caught greater quantities

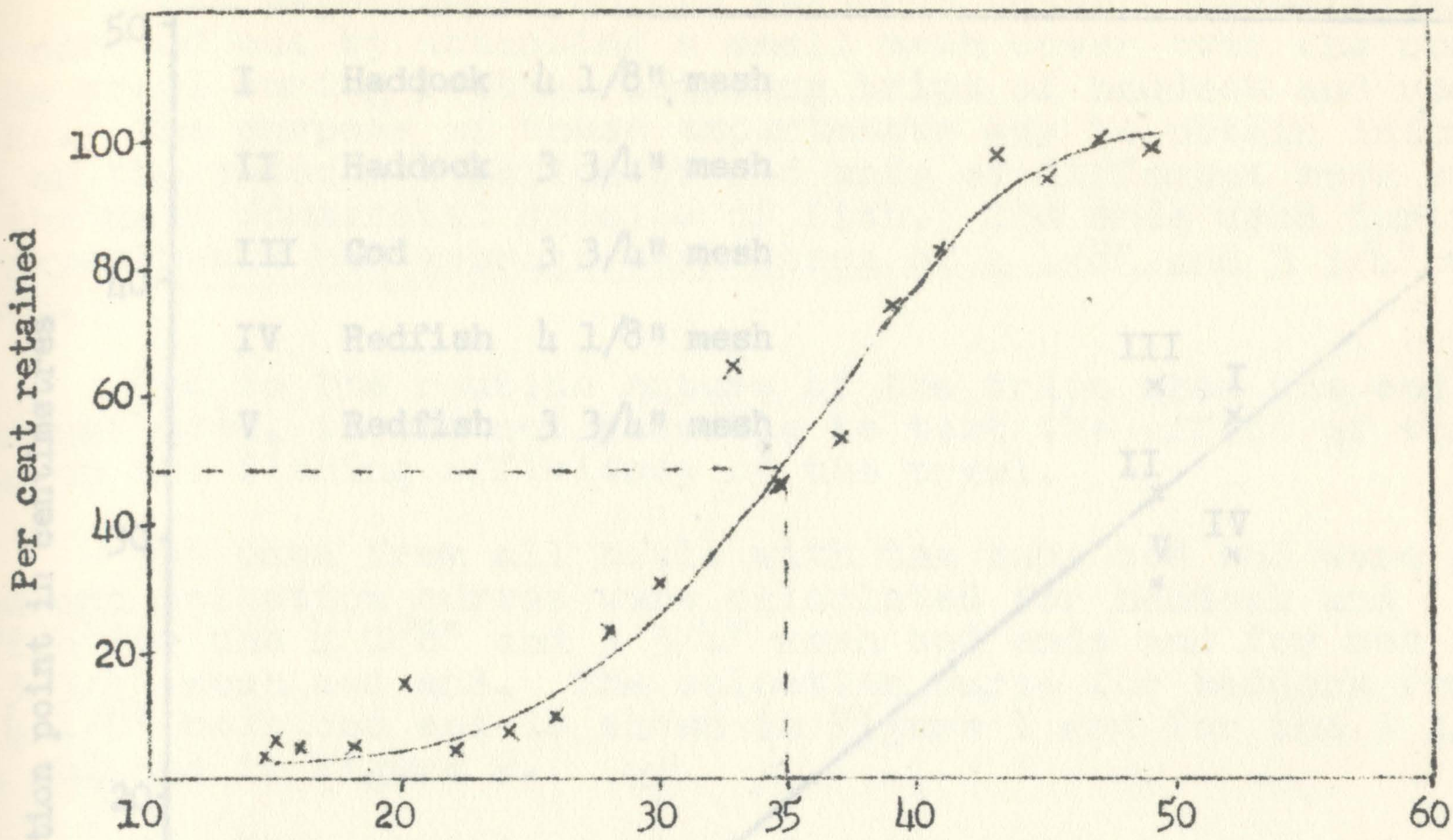


Figure 1. Selection curve for haddock with 4 1/8" mesh cod end

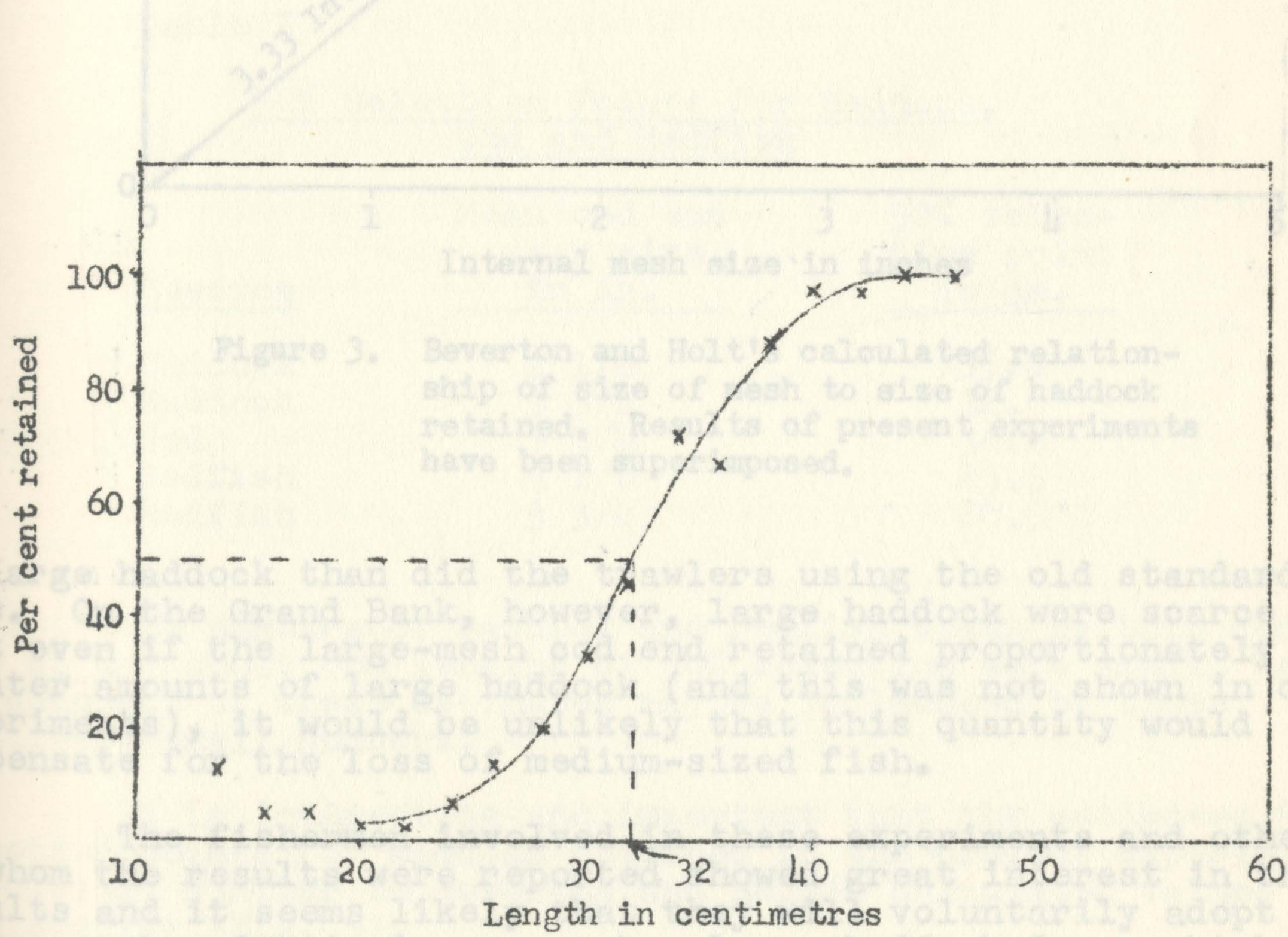


Figure 2. Selection curve for haddock with 3 3/4" mesh cod end

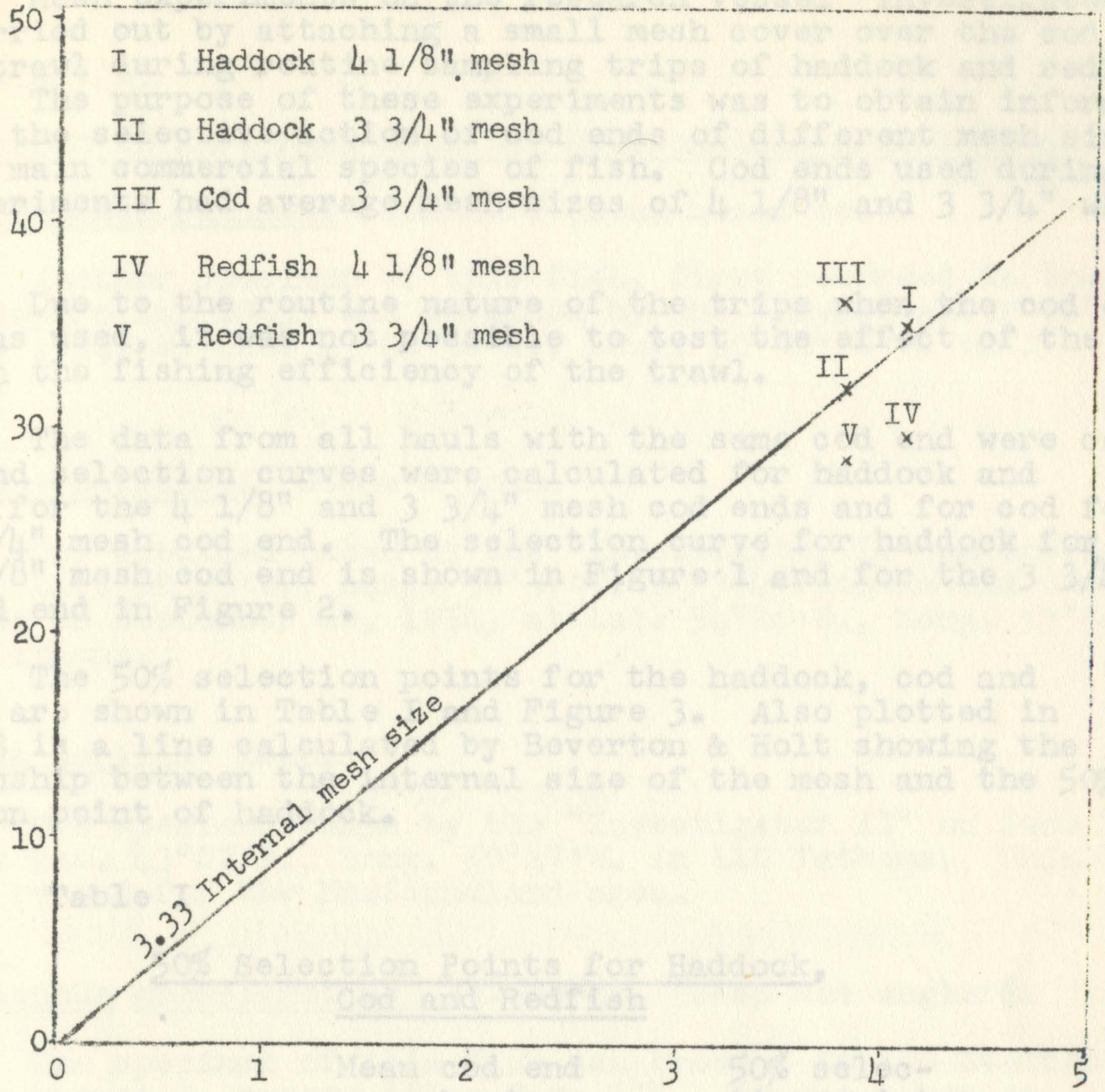


Figure 3. Beverton and Holt's calculated relationship of size of mesh to size of haddock retained. Results of present experiments have been superimposed.

of large haddock than did the trawlers using the old standard cod ends. On the Grand Bank, however, large haddock were scarce so that even if the large-mesh cod end retained proportionately greater amounts of large haddock (and this was not shown in our experiments), it would be unlikely that this quantity would compensate for the loss of medium-sized fish.

The fishermen involved in these experiments and others to whom the results were reported showed great interest in the results and it seems likely that they will voluntarily adopt larger-mesh cod ends in years when large haddock form a higher proportion of the marketable catch or when the demand for small haddock is less.

Mesh experiments on the research vessel "Investigator II" were carried out by attaching a small mesh cover over the cod end of the trawl during routine sampling trips of haddock and redfish stocks. The purpose of these experiments was to obtain information on the selective action of cod ends of different mesh sizes for the main commercial species of fish. Cod ends used during the experiments had average mesh sizes of 4 1/8" and 3 3/4" when in use.

Due to the routine nature of the trips when the cod end cover was used, it was not possible to test the effect of the cover on the fishing efficiency of the trawl.

The data from all hauls with the same cod end were combined and selection curves were calculated for haddock and redfish for the 4 1/8" and 3 3/4" mesh cod ends and for cod for the 3 3/4" mesh cod end. The selection curve for haddock for the 4 1/8" mesh cod end is shown in Figure 1 and for the 3 3/4" mesh cod end in Figure 2.

The 50% selection points for the haddock, cod and redfish are shown in Table I and Figure 3. Also plotted in Figure 3 is a line calculated by Beverton & Holt showing the relationship between the internal size of the mesh and the 50% selection point of haddock.

Table I

50% Selection Points for Haddock, Cod and Redfish

Species	Mean cod end mesh size in in.	50% selection point in cm.
Haddock	4 1/8	35.0
Haddock	3 3/4	32.0
Cod	3 3/4	36.0
Redfish	4 1/8	29.5
Redfish	3 3/4	28.5

The numbers of haddock and redfish taken by both cod ends at and about the lengths of 50% selection were small, hence the accuracy of these estimates may be influenced by these relatively small numbers.

It is interesting and important that the estimated 50% selection points for haddock obtained in the present experiments are closely similar to Beverton and Holt's calculated values for this species (Fig. 3).

R. W. Ellis

RARE FISH

Appendix No. 13

Records of Rare Fish from the Newfoundland Area 1953-54

Synaphobranchus pinnatus Gunther. (Long nosed eel).

Another specimen of this fish, first recorded in the Annual Report for 1953, was obtained by the "Investigator II" on June 28, 1954, at Lat. 43°05'30"N., Long. 50°54'00"W. in 150 fathoms.

Bathylagus benedicti Goode & Bean.

One specimen taken by the "Investigator II" on October 4, 1953, at Lat. 50°25'N., Long. 50°37'W. in 384 fathoms and two specimens on September 10, 1954, at Lat. 54°20'N., Long. 53°50'W. in 400 fathoms.

Polymixia nobilis Lowe.

One specimen taken by the "Investigator II" on June 23, 1954, at Lat. 43°07'N., Long. 50°47'W. in 110 fathoms. This is a first record for the Newfoundland area.

Himantolophus groenlandicus Reinhardt. (Deep sea angler).

One specimen of this fish was brought to the Station by the commercial dragger "Blue Haze II". It was taken on February 23, 1954, at Lat. 43°30'N., Long. 51°34'W. in 75-80 fathoms. This is a first record for the Newfoundland area.

Trachyrhynchus murrayi Gunther.

One specimen of this grenadier was taken by the "Investigator II" on September 16, 1954, at Lat. 54°50'N., Long. 53°29'W. in 390 fathoms. This is a first record for the Newfoundland area.

Lycenchelys verrilli Goode & Bean. (Wolf eel).

Two specimens were taken by the "Marinus" in December, 1953, and another in September, 1954, in Hermitage Bay. This is a first record for the Newfoundland Station.

Molva molva L. (European ling)

This specimen was landed by the otter trawler "Zibet" in Burin. It was caught approximately in Lat. 44°43'N., Long. 53°19'W. at a depth of 48 to 55 fathoms between February 3 and 8, 1953. This is the first substantiated record from North American waters south of Greenland.

Centroscyllium fabricii Reinhardt. (Black dogfish)

Nine specimens were taken by the "Investigator II" in November, 1953, from two stations in the Gulf of St. Lawrence, Lat. 48°29'N., Long. 50°12'W., and Lat. 48°15'N., Long. 60°00'W. in 200 fathoms.

D. G. Lambert

HERRING MORTALITY

Appendix No. 14

Death of Herring, West Coast of Newfoundland

Reports in late July of large numbers of dead herring floating in the inshore areas of the west coast of Newfoundland from St. George's Bay to Port aux Choix were investigated early in August.

A few dead herring were picked up floating near Bay of Islands where a herring school was seen. Examination of these herring showed no skin lesions of any kind and no internal sporozoan cysts. However, the stomach sacs in all specimens were tightly inflated, there was no food in the stomachs, and the intestines were full of greenish amorphous material.

Plankton tows in the area where the dead herring were picked up showed an abundance of calanoid copepods, and there were present also Ceratium sp. and Rhizosolenia sp. Temperatures in the inshore area were fairly high compared with temperatures in deeper water where the herring had spawned presumably in late spring. The movement of these herring inshore in late summer instead of in the spring was unusual.

It was presumed in view of these circumstances that the herring fatalities had occurred through ingestion of toxic food, most likely of phytoplanktonic origin, incidental to feeding on copepods.

Later some of these herring were sent to Dr. Margolis of the Nanaimo Station and no indication of disease organisms was found.

H. J. Squires

ATLANTIC SALMON

Appendix No. 15

Bay du Nord River

Investigation covered the count of smolts and kelts leaving and adult salmon returning to the river. In all cases the fish were marked and sampled for scales and measurements. The general river survey of conditions for spawning which was partially done in 1953 was not continued.

Smolts

Smolt Fence. The fence was situated in the same place as in 1953, a description of which was given in the Annual Report of the Newfoundland Fisheries Research Station for 1953. There was, however, one alteration. A 7/16 inch steel wire cable, from which the nets were suspended, replaced the $2\frac{1}{2}$ inch manilla rope stretching from the trap to both banks. This proved to be much more satisfactory in that weather conditions had no effect on its tension and it was much stronger than the rope.

Smolt Count. Counting, measuring and tagging were carried on the same as reported in 1953. The fence remained in good fishing order for the season except for a small hole in one of the sections for a few hours, so the count should be reasonably correct.

The fence was in complete fishing order on April 30 and the first smolts were taken May 7. The last smolt was taken on June 29 and the fence was removed July 1. The following Table gives the count of smolts and other fish taken by weeks.

The total count for this year was 8264. Of this number 6787 were tagged and 1358 were fin clipped, a total marking of 8145. Nineteen died or escaped without being marked. Two-thirds of the run occurred between May 7 and May 26 with a peak number of 1232 on May 21 while one-third appeared from May 27 to June 29 with a peak number of 336 on June 1. The high daily counts were from May 19 to 22 inclusive with 872, 610, 1232 and 979 respectively.

Week ending	Smolts	Kelts	Parr	Brook trout 6 in.& under	Brook trout 12 in.& under	Brook trout over 12 in.	Gaspereau	Smelt	Eels
May 1	-	-	-	-	-	-	-	-	-
8	12	2	16	13	16	1	-	-	-
15	230	15	115	191	48	-	-	1	-
22	4421	37	535	89	38	5	-	3	-
29	1103	2	147	34	26	-	-	3	-
June 5	1692	-	311	57	53	1	-	-	-
12	407	1	566	87	85	-	2	-	5
19	294	1	86	96	64	1	5	-	3
26	98	-	160	118	53	-	3	-	11
July 3	7	-	58	38	2	-	1	-	5
	8264	58	1994	723	385	8	11	7	24

A slight change of procedure this year was in the time of clearing the trap - 6 a.m., noon, and 6 p.m. compared with 8 a.m., 2 p.m., and 8 p.m. in 1953. Of the total count, 4879 smolts were taken during the 12-hour night period, 6 p.m. to 6 a.m., and 3385 during the 12-hour day period. Of the two 6-hour day periods, the afternoon period had the highest number, 1871, with the morning period having 1514. In both cases the results are the opposite of what was found in 1953.

A definite similarity occurring between the smolt runs of 1953 and 1954 is shown as follows:

	1953	1954
Mean fork length	163.91 mm.	169.3 mm.
Standard deviation	±14.48	±22.48
Standard error	± 0.492	± 0.789
Count	8876	8264
First smolt taken	May 6	May 7
Peak day	May 25	May 21
Numbers in peak day	1188	1232
50% of run over	May 24	May 22
Last smolt taken	June 30	June 29

The water temperature was approximately 7°C. for several days preceding the start of the run in both years. In both years there was a heavy or medium rain on the peak day and a heavy rain on the preceding day.

The size range of smolt fork lengths this year was 131 to 374 mm. compared with 132 to 291 mm. in 1953. In 1953, 1.25% of the smolts sampled was over 198 mm. while in 1954 those over 198 mm. made up 4.42%. In 1953 the largest numbers of smolts were in the 157 to 163 mm. range, making up 20.46% of the run, and in 1954 the largest numbers were in the 163 to 171 mm. range, making up 26.76% of the total run.

Smolt Marking. Of the 8264 smolts counted, 8145 were marked in various ways. Two of the types of tags that were used in 1953 were used again this year together with three other types and fin clipping. All the tags were attached immediately in front of the dorsal fin. The numbers per type were almost equal and were as follows:

Type	Description	Number
2	Pink tag, crimped wire, and disc	1360
4	Wide strip tag	1358
6	Narrow strip tag	1353
7	Red tag, crimped wire, and bar	1358
8	Red tag, crimped wire, and disc	1358
9	Fin clipped (posterior half of dorsal+adipose)	1358

Of the total number (6787) of tags attached, 31 or 0.46% have been accounted for this year as follows:

No. of returns	How and where found	% returns
20	Angled in Bay du Nord River Estuary	64.5
5	Picked up at fence	16.1
4	Caught in salmon and herring nets near estuary	12.9
2	One angled and one in salmon net outside river area	6.5

The returns from outside the river area were both taken in Fortune Bay. One was caught in a salmon net at Hare Hr., a distance of 18 miles from the tagging point, 39 days after being tagged. The other was angled a short distance up Terrenceville Brook, a distance of 40 miles from the tagging point, 69 days after being tagged.

Only four smolts of the 1953 smolt marking have been accounted for so far. One tagged and two fin clipped smolts were caught at the smolt fence and released again this year during the smolt run. Apparently they remained in the river another year after being released in 1953. Whether they were parr or smolts when marked in 1953 is questionable. The other recapture was a fin-clipped grilse which returned to Bay du Nord River and was passed through the salmon counting fence on July 8.

Kelts

During the operation of the smolt fence the largest numbers of kelts descending coincided with the peak of the smolt run. In 1953 the kelt peak was a week earlier than the smolt peak. The total number of kelts passed through the smolt trap was 58 as compared with 56 in 1953. Twenty-four had tags

attached from 1953 tagging, 4 had wire only, 6 had scars where tagged, and 24 had not been tagged. Of the 97 salmon and grilse tagged while ascending the river in 1953, ten or 10.3% lost their tags and five or 5.5% were caught in the commercial fishery of 1954. Of the latter, two were taken in Placentia Bay and three in Fortune Bay, all to the east of Bay du Nord River. The 10.3% that lost their tags would be a minimum figure since the fence was not in operation during the winter and therefore all the kelts were not examined.

Salmon

Salmon Count. The salmon trap and fence were placed in the river approximately in the same place as in 1953. The trap, however, was placed on the opposite side of the smolt trap in order to be in deeper water during the dry periods of the summer. A 7/16 inch steel wire cable was used to suspend the bar nets and one arm of the fence was shortened by 120 feet. Otherwise the fence was essentially the same as the one used in 1953. It was in complete fishing order by June 3 and the first salmon was taken June 18. Experience the previous year indicated that salmon were reluctant about entering the trap when the water was low and there was little current. Consequently on July 6 another fence was placed in the river, approximately a half mile farther down stream where the river narrowed considerably. Here the current was much stronger and the depth of water around 9 feet at high tide as compared with 4 feet at the upper fence. Salmon entered this trap readily but due to the strong current and the make-shift nature of the fence it was a difficult task to keep the fence in working order and the experiment was discontinued on August 14 when several sections washed out. The count was 27 salmon and grilse at the lower fence and 28 at the upper fence plus three which had passed through the lower fence. These three fish spent 1, 5 and 9 days between fences. Of the remaining fish that passed through the lower fence, three were found dead and 21 were unaccounted for when the upper fence was removed on October 19.

The total count of salmon and grilse for the season was 55 while the count in 1953 was 151. The weekly counts of salmon and grilse for the two years are given in the Tables below. The percentages of salmon and grilse in the two years are reversed. The first salmon was taken and the peak of the run occurred approximately the same time both years. However, the run continued on into October in 1953 whereas it ended abruptly early in August in 1954. The scarcity of salmon in 1954 cannot be attributed to lack of water to induce them into the river because there was plenty of rainfall and the river remained fairly high most of the summer.

1953

Week ending	Salmon	Grilse	Total
June 20	1	1	2
27	6	6	12
July 4	8	13	21
11	8	21	29
18	7	17	24
25	1	10	11
Aug. 1	-	-	-
8	5	11	16
15	-	4	4
22	3	2	5
29	-	-	-
Sept. 5	4	3	7
12	-	-	-
19	-	1	1
26	-	3	3
Oct. 3	10	6	16
	53 (35.1%)	98 (64.9%)	151

1954

Week ending	Salmon	Grilse	Total
June 19	1	-	1
26	4	1	5
July 3	13	3	16
10	10	4	14
17	3	2	5
24	2	6	8
31	-	3	3
Aug. 7	1	2	3
	34 (61.8%)	21 (38.2%)	55

A. A. Blair

Appendix No. 16

Little Codroy River

The Atlantic salmon research program for 1954 on the Little Codroy River had two main objectives. One was investigation of the utilization of the salmon stock in sport and commercial fisheries; the other, the study of size and age-class composition of the salmon stock in order to provide basic information on the character of the fishery. A counting fence

was operated on the river for gathering data pertaining to these objectives.

The fence is located in the estuary of the Little Codroy River, below all tributaries, about one mile from the ocean, and about three miles below the upstream limit of brackish water. The river at this site is 810 feet wide. During the period that the fence was in operation, the depth of water in midstream - where the traps were located - varied from 6.5 feet to 8.5 feet. The rise and fall of the tide within the estuary was about one foot.

The counting fence on the Little Codroy River is patterned after that in operation on the Bay du Nord River. The fence, trap, maintenance procedures, and method of handling the fish have been described in the 1953 Annual Report.

Smolt Studies

The counting fence for smolts was completed May 14 and remained in good fishing order for the duration of the season. As soon as the fence was put into operation, a smolt was captured, and it is felt, therefore, that the seaward migration of smolts had already started by that date. The migration very slowly built up to a peak of 541 on June 6, declined to 87 on June 9, then rose to a second peak of 1280 on June 12, declined to 146 on June 18, and then rose to a third peak of 837 on June 22, and declined rapidly thereafter. The last migrant was counted July 14, and the fence was removed July 18. The total count of smolts for the period that the fence was in operation was 12,210. Of this number, 173 smolts did not recover from the anaesthetic.

The trap was cleared of fish three times daily: 6 a.m., 12 noon, and 6 p.m. standard time. Eighty-seven per cent of the smolts were captured during the period from 6 a.m. to 6 p.m. (Table I). The reason for the small number of smolts trapped during the night from 6 p.m. to 6 a.m. may be due, in part, to the large number of eels which were also captured during this period; 75% of the total eel capture was taken from 6 p.m. to 6 a.m. (Table II). The inference is that smolts would not enter the trap during the period when eels are active, or that many smolts were eaten by eels after having entered the trap. Some evidence has been obtained to substantiate the latter statement. The counts of other fish which were taken in the smolt trap are summarized in Table III.

Table I.

Numbers of Atlantic Salmon Smolts Captured in the Smolt Counting Fence, Little Codroy River, 1954

Time of trap clearance	May 14-31	June 1-15	June 16-30	July 1-18	Totals
0600	59	427	1,051	75	1,612
1200	166	2,723	2,555	60	5,504
1800	344	1,739	2,627	384	5,094
Totals	569	4,889	6,233	519	12,210

Table II.

Numbers of Eels Captured in the Smolt Counting Fence, Little Codroy River, 1954

Time of trap clearance	May 14-31	June 1-15	June 16-30	July 1-18	Totals
0600	630	761	208	35	1,634
1200	171	52	16	21	260
1800	62	121	61	46	290
Totals	863	934	285	102	2,184

Table III

Numbers of Fish Captured in the Smolt Counting Fence, Little Codroy River, 1954

Species	May 14-31	June 1-15	June 16-30	July 1-18	Totals
Salmon kelts	124	107	16	6	253
Brook trout	408	532	230	31	1,201
Smelt	216	843	513	10,599	12,171
Tomcod	87	62	148	23	320
Winter flounder	268	82	144	30	524

All the smolts taken at the trap were marked by the removal of the dorsal and adipose fins. Every tenth smolt was measured, weighed, and scale sampled.

Adult Studies

The seaward migration of some Atlantic salmon kelts in the Little Codroy River occurred at the same time as the smolt

run. The migration slowly built up to a peak of 31 on May 23, declined to zero on May 31, then rose to 31 on June 2, and declined slowly thereafter. The total count of kelts for the period that the fence was in operation was 253 (Table III).

Each kelt was measured, weighed, scale sampled, and marked using an Atkins-type tag which was attached just in front of the dorsal fin. There have been seven returns from the kelt tagging and these are summarized as follows:

Date tagged	Place recaptured	Distance (miles) from fence	Tagging-recapture interval (days)
May 23	Harbour Mille (Fortune Bay, south coast Nfld.)	229	43
May 23	Raleigh (Strait of Belle Isle, Nfld.)	330	62
June 7	Searston Bay (North of Little Codroy R., west coast Nfld.)	7	14
June 12	Searston Bay	7	3
June 3	Larkin Point (Just outside mouth of Little Codroy R.)	2	68
June 4	Larkin Point	2	62
June 4	Larkin Point	2	62

The last three entries in the Table represent recaptures of fish which were presumably returning to the Little Codroy River, and were 1.5, 4.2, and 5.0 pounds, respectively, heavier than when they were tagged.

The counting fence for recording adult Atlantic salmon moving upstream in the Little Codroy River was completed June 17 and remained in good fishing order for the duration of the season. The run tended to be divided into two unequal parts. The first portion began June 18 and ceased August 27, with 76% of the fish passing through the fence between July 2 and July 22. The second portion began September 7 and continued sporadically until October 9. The total count of adult salmon moving upstream was 215, and is summarized below:

	June 17-30	July 1-31	Aug. 1-31	Sept. 1-30	Oct. 1-9	Total
Number of salmon	4	165	40	1	5	215

Each salmon was measured, weighed, scale sampled, and marked using an Atkins-type tag. A creel census, obtained through the return of salmon tags, indicates that 26% of the salmon which migrated upstream were taken by angling (Table IV). Although the salmon angling season opened May 15 on the Little Codroy River, angling did not begin until July 10, about

one month after the first salmon had passed through the fence, and about one week after the concentration of the run had begun. Thirty-eight per cent of the salmon were angled in pools three to six miles from the fence, with 43% of these caught during July. On the other hand, 55% were taken in pools nine to twelve miles from the fence with 55% of these angled during August.

Table IV

Distance (miles) recaptured upstream from fence	July 10-31	Aug. 1-31	Sept. 1-15	Totals
0.1-3.0	0	2	0	2
3.1-6.0	9	8	4	21
6.1-9.0	0	2	0	2
9.1-12.0	7	17	7	31
Totals	16	29	11	56

A. R. Murray

ARCTIC CHAR

Appendix No. 17

Arctic Char, Northern Labrador, 1953

During the summer of 1953, data on the biology of Arctic Char were collected in Northern Labrador from the commercial catch, in which standard $4\frac{1}{2}$ inch gill nets were used. No field work was attempted in 1954 but the 1953 data were carefully examined in the laboratory.

Age Frequencies

Age frequencies are recorded in Table I; it can be seen that at Adlatok - the most southerly sample, the dominant age-group is 7 with 8 a close second. Proceeding north to Nain, the dominant age-group is 9 as is also the case at Okak Bay and Hebron. At Ramah - the most northerly sample - the dominant age-group is 11 with 9 and 10 close seconds. Geographically as well as ecologically Adlatok and Nain to the south may be regarded as areas distinct from Okak Bay, Hebron and Ramah in the north. The former lie in inland sheltered waters whereas the latter, except for Okak Bay, are exposed on the open coastline and in direct contact with the Labrador Current. The two areas are separated also by the towering Kiglaipait Mountains.

Table I

Age Frequencies of Arctic Char, Northern Labrador
July-August, 1953

Station	Number of fish at each age in years															Total fish	Mean age	Stand. dev.	Stand. error
	5+	6+	7+	8+	9+	10+	11+	12+	13+	14+	15+	16+	17+	18+	19+				
Adlatok	1	6	23	20	12	14	6	2	2							86	8.44	1.691	0.180
Nain		3	18	24	30	19	12	6	0	0	0	0	1			113	9.00	1.658	0.156
Okak Bay			3	15	31	22	20	15	10	1	0	1				118	10.17	1.696	0.156
Hebron			4	5	20	16	8	7	7	4	2					73	10.37	1.969	0.230
Ramah	1		5	12	19	18	21	15	9	4	7	0	1	0	1	113	10.73	2.310	0.220

It can be noted that whereas 10 fish in the age-groups 5 and 6 were taken at Adlatok and Nain, none were taken in those age-groups at Okak Bay and Hebron, and only 1 was taken at Ramah. Also it can be seen that whereas only 11 fish were taken at Adlatok and Nain in the 12-year and higher age-groups a total of 84 fish was taken in the Okak, Hebron, and Ramah samples. The tendency is, therefore, towards older fish as one proceeds north. This trend is also evident in the mean age, where Adlatok reads 8.4 years and Ramah 10.7 years.

Weight Frequencies

Table II shows that the sample at Adlatok was well represented in the 2- to 6-pound weight classes; in recent years less intensive fishing has been going on in this area because of base construction activities at nearby Hopedale. At Nain, nearly half the sample was in the 2-pound class with 3-pounders well represented. In the north, 2-pounders remain the dominant weight-class.

The mean weight of the Adlatok sample was 4.4 pounds with a general decrease in weight proceeding north.

Table II

Weight Frequency, Arctic Char, Northern Labrador
July-August, 1953

Station	No. of fish at each whole weight (lb.) 1	2	3	4	5	6	7	8	9	Mean weight	Stand. dev.	Stand. error
Adlatok	0	14	18	20	13	14	3	7	1	4.41	1.810	0.191
Nain	19	52	31	16	1	2				2.45	1.041	0.090
Okak Bay	30	57	25	7	1					2.10	0.870	0.080
Hebron	4	46	38	21	8	2	0	1		2.95	1.150	0.110
Ramah	12	66	25	10	3	2	1	0	1	2.52	1.220	0.110

Table III shows that the dominant length-group at Adlatok was 55-59.9 cm., and at Nain, Hebron and Ramah 45.0-49.9 cm. Okak Bay, however, has a dominant length-group of 40-44.9 cm.

The mean length of Adlatok fish was 57.1 cm. with samples farther north in the order of 47.8, 47.2, 47.9, and 47.4 cm. respectively.

Table III

Length Frequency, Arctic Char, Northern Labrador
July-August, 1953

Length group	Number of fish in each cm. length group				
	Adlatok	Nain	Okak Bay	Hebron	Ramah
30.0-34.9		1			
35.0-39.9		3	7	1	6
40.0-44.9	4	24	54	12	37
45.0-49.9	18	44	34	52	43
50.0-54.9	17	33	19	40	24
55.0-59.0	31	13	4	9	4
60.0-64.9	13	3	1	2	3
65.0-69.9	6				
70.0-74.9					
75.0-79.9					
Total fish	89	121	119	116	117

Age-Length Relationship

Mean length for age-groups of all samples is shown in Table IV. In general, the mean length of a given sample increases with increase in age. Also, in any given age-group, covering all samples, the mean length decreases with increase in latitude. At Adlatok, for example, 8-year-old char had a mean length of 55.5 cm. while at Ramah the same age-group had a mean length of only 43.4 cm. - a difference of 12.1 cm.

When the Adlatok-Nain samples are combined and compared with the combined northerly samples of Okak Bay, Hebron and Ramah the trend is all the more apparent as shown in Table V.

Table IV

Summary of Age-Length Relationships of Arctic Char,
Northern Labrador, 1953
(Figures in brackets indicate number fish in each age-group)

Age (years)	Mean length (cm.)				
	Adlatok	Nain	Okak Bay	Hebron	Ramah
5	44.50 (1)				
6	47.83 (1)	39.83 (3)			42.70 (1)
7	49.78 (23)	45.38 (18)	41.83 (3)	47.50 (4)	42.40 (5)
8	55.50 (20)	47.67 (24)	44.26 (15)	48.80 (5)	43.42 (12)
9	58.62 (13)	50.06 (30)	45.74 (31)	48.43 (21)	43.84 (18)
10	57.77 (13)	49.66 (19)	46.04 (22)	49.72 (14)	47.77 (18)
11	63.50 (6)	53.54 (13)	45.10 (20)	50.77 (8)	47.25 (21)
12	60.75 (2)	50.66 (6)	45.87 (15)	52.55 (9)	50.80 (16)
13	62.85 (2)		48.30 (10)	52.57 (7)	48.38 (8)
14			43.40 (1)	46.50 (4)	54.45 (4)
15				48.70 (2)	60.33 (6)
16			62.00 (1)		

Table V

Summary of Age-Length Relationships of Arctic Char, Northern Labrador, 1953

Age (years)	Mean length (cm.) Adlatok-Nain	Okak-Hebron-Ramah
5	44.50	
6	43.83	42.70
7	47.58	43.91
8	51.58	45.49
9	54.34	46.00
10	53.71	47.84
11	58.52	47.71
12	55.70	49.74
13	62.85	49.75
14		48.12
15		54.52
16		62.00

Age-Weight Relationship

Table VI shows the relationship between age and whole and gutted weight. Increase in weight is associated with increase in age in all samples. At Nain, however, fish of 12 years - oldest in the sample - weighed less than 9, 10 and 11 year-olds and at Hebron fish of 14 years - oldest in the sample - weighed less than age-groups 7 to 13 inclusive.

In a given age-group, Adlatok and Hebron fish respectively weighed more than fish of the same age-group at Nain, Okak Bay and Ramah; in the 8 year-old-group, for example, the order is as follows for whole fish: Adlatok 4.5, Hebron 3.5, Nain 2.6, Okak Bay 2.3, and Ramah 2.3 pounds.

Table VI

Age-Weight Relationship, Arctic Char, Northern Labrador, 1953

Age (years)	Mean weight (lb.) Aalatok		Nain		Okak Bay		Hebron		Ramah	
	Whole	Gutted	Whole	Gutted	Whole	Gutted	Whole	Gutted	Whole	Gutted
5										
6	3.17	2.80	1.42	1.07						
7	3.47	3.15	2.15	1.79		1.58	3.25	2.60	2.05	1.75
8	4.86	4.47	2.64	2.20	2.25	1.88	3.46	2.78	2.27	1.82
9	6.25	5.64	3.04	2.61	2.54	2.16	3.32	2.76	2.31	1.82
10	5.33	4.92	2.88	2.30	2.46	2.04	3.50	2.88	2.97	2.48
11	7.27	6.82	3.63	3.15	2.24	1.86	3.83	3.10	2.88	2.41
12			2.76	2.33	2.40	2.00	4.35	3.56	3.32	2.81
13					2.77	2.32	3.50	2.88	2.89	2.33
14							2.51	2.08	3.56	3.00
15									5.32	4.58

Vertebral Counts

The range of vertebral counts was from 62 to 68 as shown in Table VII; the Table also shows the frequency of each count. The mean vertebral count shows an increase progressing northwards; at Adlatok, for example, the count is 64.45 and at Ramah 65.28.

Table VII

Vertebral Frequencies, Arctic Char, Northern Labrador, July-August, 1953

Station	Vertebral frequencies								No. fish	Mean vert. no.	Stand. dev.	Stand. error
	62	63	64	65	66	67	68	69				
Adlatok	4	7	38	29	12	1			91	64.45	1.003	0.105
Nain		8	37	49	23	3	1		121	64.82	0.954	0.087
Okak Bay	2	10	36	40	24	4			116	64.74	1.047	0.097
Hebron			15	50	36	14	2		117	65.47	1.027	0.092
Ramah		1	25	45	32	9	3		115	65.28	1.000	0.094

Fin Ray Counts

Table VIII shows the mean fin ray count for dorsal, pectoral and anal fins. It can be seen that, as in the case of vertebral counts, there is a general increase in the number of fin rays for each fin with increase in latitude.

Table VIII

Mean Fin Ray Counts, Arctic Char, Northern Labrador, July-August, 1953

Station	Dorsal	Pectoral	Pelvic	Anal
Adlatok	14.46	13.61	10.03	12.98
Nain	14.51	13.85	10.10	13.09
Okak Bay	14.34	13.88	10.15	13.24
Hebron	14.56	14.18	10.27	13.20
Ramah	14.74	13.96	10.16	13.28

For data on commercial importance, muscle colour, parasitism, and food, see Annual Report for 1953.

C. W. Andrews
E. Lear

MARINE MAMMALS

Appendix No. 18

Harp Seals

Research on harp seals is carried out jointly by the Atlantic Biological Station and the Newfoundland Station. As field work in 1954 was carried out only by the Newfoundland Station, the greater part of completed work is presented in this report.

Sincere thanks are rendered to Karl Karlsen, Ltd., of Halifax, for accommodations and research facilities provided on their sealing vessel "Theron" in March and April, and to Capt. Marø and complement for their interest and assistance during the voyage.

Tagging and Tagging Returns in 1954

Tagging was carried out from the "Theron" in the Gulf of St. Lawrence. About 120 young seals were estimated effectively tagged between March 6 and 14 in the ice lying between the west shore of Cape Breton Island, Prince Edward Island and the Magdalen Islands. Five returns up to April 16 show a dispersal of the young seals to the Magdalen Islands and the N.E. coast of Cape Breton. There have been no recoveries reported to date further north.

Further returns from seals tagged in 1952 and 1953 number seven. These include:

a. Two one-year-old immatures, one taken at the Front on March 25, 120 miles east of the Funks and one on April 1 at Greenspond, Bonavista Bay, Newfoundland.

b. One from Cape Bauld at the northern tip of Newfoundland in mid-January and two from west Greenland at latitude 65°N. on January 22 and February 9, all seals in their first year. These recoveries (and a previous one from west Greenland) demonstrate that some one-year-old seals remain in the Arctic until this time, while some migrate south with the adults. This pattern had first been inferred from the age-frequencies, which show a low representation of young seals in November-December in northern Labrador and in January on the north shore of the Gulf of St. Lawrence. (See 1953 Annual Report, p. 58).

c. The first two recoveries from the Canadian arctic. These are both of $1\frac{1}{2}$-year-old seals, and come from the east coast of Baffin Island; from Cumberland Sound in the early fall of 1953, and from Clyde Inlet in mid-August, 1954. Previously all recoveries in summer had come from west Greenland, where however the hunting intensity is greater than in the Canadian arctic.

Composition of Moulting Patches of Harp Seals by Age and Sex

The moulting patches at the Front consist at first of bedlamers (immature seals) and mature males in separate groups. These gradually coalesce to form mixed groups, together with a few adult females. However, the majority of the females which have whelped are absent and do not join the moulting patches until late April. Observations made in 1954 show that, in general, the younger females, with pale saddles, arrive earlier than the older with dark saddles.

Samples of lower jaws were collected from seals shot on different days and the teeth later "read". The Table shows the percentage of younger (1 to 5 years) and older seals of both sexes. Data end with the completion of the voyage of the "Theron", at a time when females were coming in rapidly.

Table I

Composition of Moulting Patches by Sex and Age

	Males			Females			
	Number		%	Number		%	%
	Young	Old	old	Young	Old	old	males
March 29 and 31	36	24	40.0	27	1	3.6	68.2
April 6 (2 patches)	66	6	8.4	42	3	6.7	61.6
April 10 and 14	37	40	52.0	48	4	7.7	59.7
April 17 and 21	28	43	60.5	24	8	25.0	68.9
April 22 and 24	20	53	72.6	8	35	81.4	62.9
						Overall	64.3

Table I shows that, with the exception of April 6 when predominantly bedlamers were met with, the moulting patches in April consisted of a majority of old male seals. These appear to increase slowly throughout the month. Adult females began to appear about April 21 and were numerous by April 24.

Observations and similar analyses were made by H. D. Fisher and B. A. McKenzie of the Atlantic Biological Station in 1953. They were able to collect samples up to April 27, and found an increase in the percentage of females taking place from April 24 (10%) to April 27 (40%). In both years observations ceased before the females had fully entered the moulting patches. However, it seems likely that the influx is complete by about the end of the month, when the sex ratio should be close to 50:50. Thus a closing date for sealing vessels imposed late in April would provide very complete protection for the breeding females.

Age-Sampling of Harp Seals

In 1954, samples of teeth were collected, as in the previous year, from northern Labrador on the seals' southward migration, and from the icefields during the moulting season. A sample of 379 from Hebron and Nutak is the largest that could be obtained from the Labrador stations because of a low catch at Nutak. A sample of 618 was collected from the "Theron" at the icefields; these are moulting seals, and as in previous collections, contain a high proportion of one-year-old immatures.

Age-frequencies are shown in Figures 1 and 2. In Labrador the dominant age-class is the 4-year-old one, representing seals born in 1950. The sample from the ice shows good representation of the two-year (1952) and 4-year (1950) classes, and low survival of the 3-year (1951) and 5-year (1949) classes. Figure 3 shows a large sample collected at the ice in 1953, for comparison. Nine samples have now been analysed by the research groups at the Atlantic Biological Station and at this Station. Results are summarized in Table II.

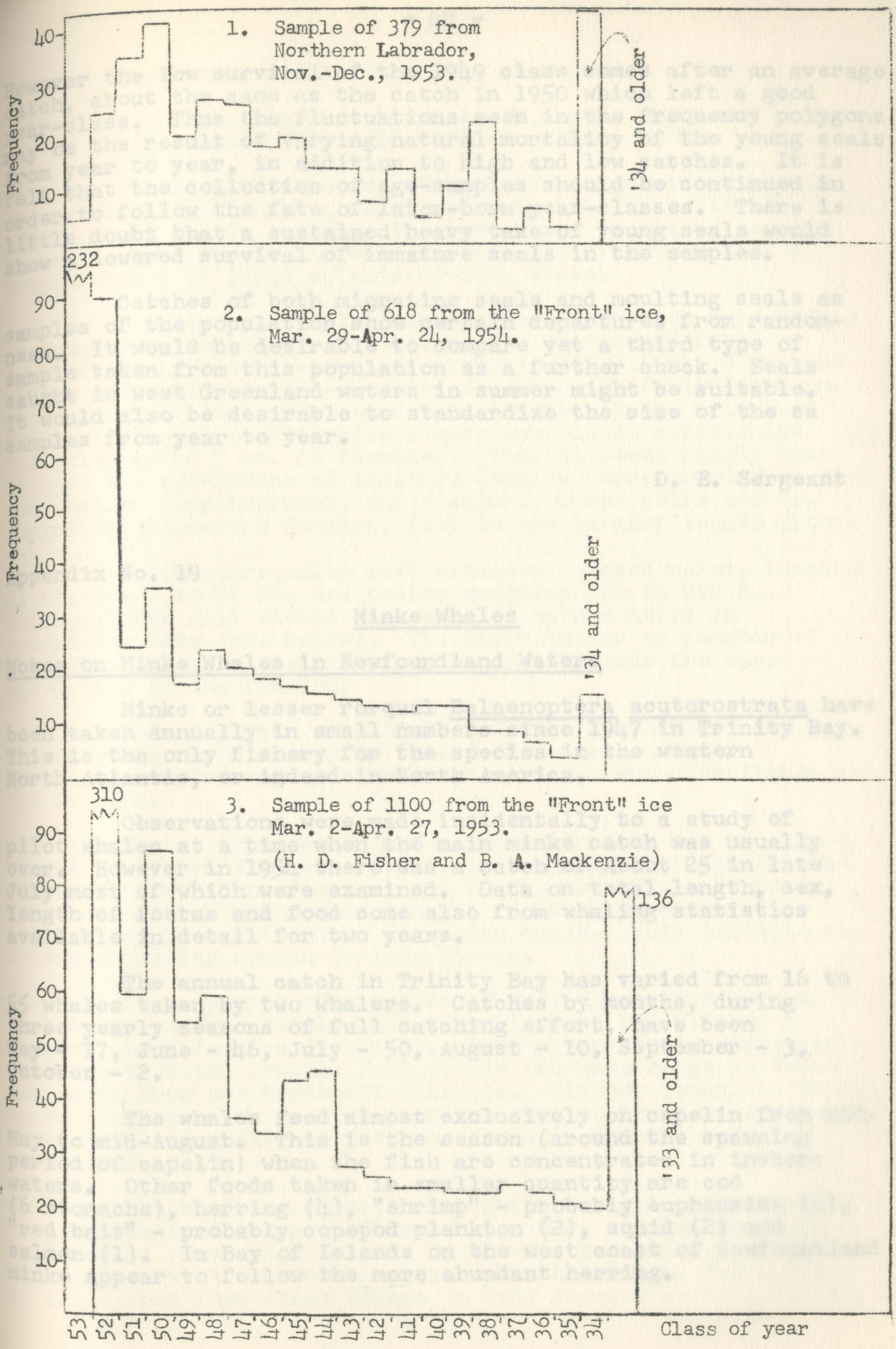
Interpretation of year-groups has been limited to ages 2-5 years, since the 1-year-olds are over-represented at the icefields and since above five years, low numbers and a proportion of incorrect readings are thought to make the peaks and troughs of doubtful significance. On the southward migration age groups 1 to 3 at least, are under-represented and cannot be compared with older groups.

Table II

Strength of Year-classes of Harp Seals Aged 2 to 5 Years

Locality of sample	Date of collection	1952	1951	1950	1949	1948	1947
La Tabatiere Ice, from "Blue Seal" Northern Labrador	Jan. 1952			High	Low	High	Dominant
	Apr. 1952			High			
	Nov.-Dec. 1952					Dominant	
La Tabatiere Ice, from "Theron"	Jan. 1953					Dominant	
	Mar.-Apr. 1953		Low	High	Low	High	
Ice, from "Algerine" Northern Labrador	Mar.-Apr. 1953			High	Low	High	
	Nov.-Dec. 1953			Dominant	Low		
Ice, from "Theron"	Mar.-Apr. 1954	High	Low	High	Low		

Table II shows good agreement on high and low year-classes. The low survival of the 1951 year-class can be related to a very high catch of young seals in that spring.



Figures 1 to 3. Age frequency of harp seals

However the low survival of the 1949 class comes after an average catch, about the same as the catch in 1950 which left a good year-class. Thus the fluctuations seen in the frequency polygons may be the result of varying natural mortality of the young seals from year to year, in addition to high and low catches. It is felt that the collection of age-samples should be continued in order to follow the fate of later-born year-classes. There is little doubt that a sustained heavy take of young seals would show a lowered survival of immature seals in the samples.

Catches of both migrating seals and moulting seals as samples of the population show certain departures from randomness. It would be desirable to compare yet a third type of sample taken from this population as a further check. Seals caught in west Greenland waters in summer might be suitable. It would also be desirable to standardize the size of the sa samples from year to year.

D. E. Sergeant

Appendix No. 19

Minke Whales

Notes on Minke Whales in Newfoundland Waters

Minke or lesser rorqual Balaenoptera acutorostrata have been taken annually in small numbers since 1947 in Trinity Bay. This is the only fishery for the species in the western North Atlantic, or indeed in North America.

Observations were made incidentally to a study of pilot whales at a time when the main minke catch was usually over. However in 1954 there was a catch of about 25 in late July most of which were examined. Data on total length, sex, length of foetus and food come also from whaling statistics available in detail for two years.

The annual catch in Trinity Bay has varied from 16 to 55 whales taken by two whalers. Catches by months, during three yearly seasons of full catching effort, have been May - 17, June - 46, July - 50, August - 10, September - 3, October - 2.

The whales feed almost exclusively on capelin from mid-May to mid-August. This is the season (around the spawning period of capelin) when the fish are concentrated in inshore waters. Other foods taken in smaller quantity are cod (6 stomachs), herring (4), "shrimp" - probably euphausids (4), "red bait" - probably copepod plankton (2), squid (2) and salmon (1). In Bay of Islands on the west coast of Newfoundland minke appear to follow the more abundant herring.

The length of 118 whales caught was:

males (66) - 15 to 28 ft., mean 24 ft.
females (52) - 16 to 30 ft., mean 24 ft.

The length-frequency distribution suggests a division of the stock into three groups, approximately 15 to 19, 19 to 23 and 24 to 28 ft. in length. The percentage of whales in each group is about 14, 18 and 68 respectively. There is thus a preponderance of large animals of both sexes.

Considering females alone, these have been recorded as pregnant at a length of 25 ft. and up. Ovaries of four immature females were examined: two, lengths 16 ft. 9 in. and 18 ft. had small, smooth-surfaced ovaries with follicles 2 mm. in diameter or less, the other two, lengths 19 ft. 4 in. and 21 ft. had large ovaries with a much convoluted surface and follicles up to 5 mm. in diameter. Thus it seems likely that we have two age-groups of immature females corresponding to the two smaller length-groups, while animals three years and up, including all mature females, fall in the largest length group.

No immature males were examined. Seven males, lengths 23 ft. 5 in. to 27 ft. had testes weighing 300 to 700 g., which weights fall within the range of mature males in Jonsgård's data (see below). The distribution of lengths of the males suggests that they may be divided into the same age-groups as the females.

Baleen plates were collected from 20 whales. The age of the younger whales may be "read" from these using a specially constructed machine which is not however available at the Station.

Twelve foetuses from females taken from May to August ranged in length from 9 to 92 cm. in length, with mean lengths of 40 cm. for 3 June foetuses and 70 cm. for 6 July foetuses. These are close to the mean lengths of foetuses measured by Collett and Jonsgård on the Norwegian coast. They indicate an extended pairing season in late winter.

Measurements of a number of body dimensions were made on 4 males and one female, and dimensions of the flipper in 9 males and 5 females (Table I). Body proportions, expressed relative to total length, fall within the same range as found for minke from the Northeast Atlantic. Flipper length is found to be significantly greater in males than in females, otherwise there is no disparity between the sexes in somatic body dimensions.

The stock of minke in the Northeast Atlantic supports a large Norwegian fishery. These whales were studied in detail by Jonsgård (Norwegian Whaling Gazette 5, May 1951). As far as our data show, the stock of minke taken in eastern Newfoundland do not differ from those others in body form, size at maturity,

Table I

Body Proportions of Minke Whales from Trinity Bay

Measurement	No. whales measured	Range (% of total length)	
Anterior			
Tip of snout to blowhole	4	11.8 -15.9	
Tip of snout to centre of eye	5	17.6 -19.6	
Posterior			
Notch of flukes to dorsal fin	4	27.7 -34.4	
Notch of flukes to anus	4	24.5 -26.0	
Tail			
Span of flukes	4	13.4 -14.2	
Flipper			Mean
Axilla to tip (♀♀	5	9.10-10.65	9.79
(♂♂	9	10.0 -10.9	10.4

or breeding season. In the large percentage of mature animals present, they resemble that part of the European stock which summers in the high arctic region; immature whales were found to be more common in catches farther south along the Norwegian coast.

D. E. Sergeant

Appendix No. 20

Pilot Whales

Distribution in 1954

Pilot whales were first recorded from Hermitage Bay on June 26 and from the extreme southwest of the Grand Bank on June 27. They were seen in Placentia Bay between July 3 and 12. In Trinity Bay the first were taken by harpoon on July 6, within three days of the first appearance of squid in large numbers.

Driving began on July 16, and about 1100 whales were taken in drives up to August 10. Thereafter, the whales became scarce, only one drive being made in September. However, late in the season several drives took place between October 29 and November 8, and one in Bonavista Bay on October 18. Further north, many pilot whales were observed on the outer edge of Hamilton Inlet Bank off the southern Labrador coast between September 3 and 19 and they were apparently numerous in Notre Dame Bay in the second part of September.

Squid were numerous inshore on the east coast all summer but were also taken in trawls on the northeast Grand Bank, which implies unusual abundance offshore also. It is thought that this distribution was brought about by an unusually thin surface layer of warm water, which persisted all through the summer. A spread of squid farther offshore and farther north than usual could account for the occurrence of pilot whales in mid-Labrador waters, and their almost total absence from Trinity Bay in August and September when the water is warmest.

Growth and Age Composition

In July and August, 1954, a sample of 430 teeth was collected from pilot whales taken in drives. Care was taken to avoid selecting either large or small whales. The lengths of a rather larger measured sample show the same frequency-distribution as in 1952 and 1953 (shown in the 1953 Annual Report, p. 66). A grinding machine similar to that in use at the Atlantic Biological Station was delivered in early October, and with it the sample of teeth could quickly be prepared for "reading".

In previous years, 237 teeth had been collected and read, these being taken from selected animals of all sizes. The combined samples have been used to construct curves of growth for the two sexes (Figure 1), the mean length at each age being plotted against age. The curves show that growth of the females and immature males is similar, except that the males retain a slightly greater growth rate already evident at birth. At sexual maturity, however, males show a renewed high growth rate which brings them to a mean length of 18 ft. as against 15 ft. for the females. This renewed growth accounts for the low percentage of males, lengths 15 ft. to 17 ft., seen in the length-frequency histograms. Similar, but less marked, higher growth at sexual maturity is characteristic of the females: it is seen in the histograms at lengths of 11 ft. 3 in. to 12 ft. 3 in. though it is not clearly evident in the female growth curve.

The 1954 tooth-collection alone is unselected and can be used to construct an age frequency. This is shown in Figure 2. Since the sample is rather small, the sexes have been combined. The chief difficulty in reading has been the filling in of many of the older teeth to the centre, with later erosion and redeposition of dentine. This occurs at an average age of about 15 years. The exact age of these teeth being unknown, they are omitted, and the age-groups 12 and up are underrepresented. The greatest age recorded is 22 years, but the number of filled teeth - 21% of the females and 11% of the males - suggests that greater ages are reached.

The apparent excess of animals, aged 12-15 years in the histogram, is probably due to reading the apparent age of other, almost completely filled, teeth as the real age, when in

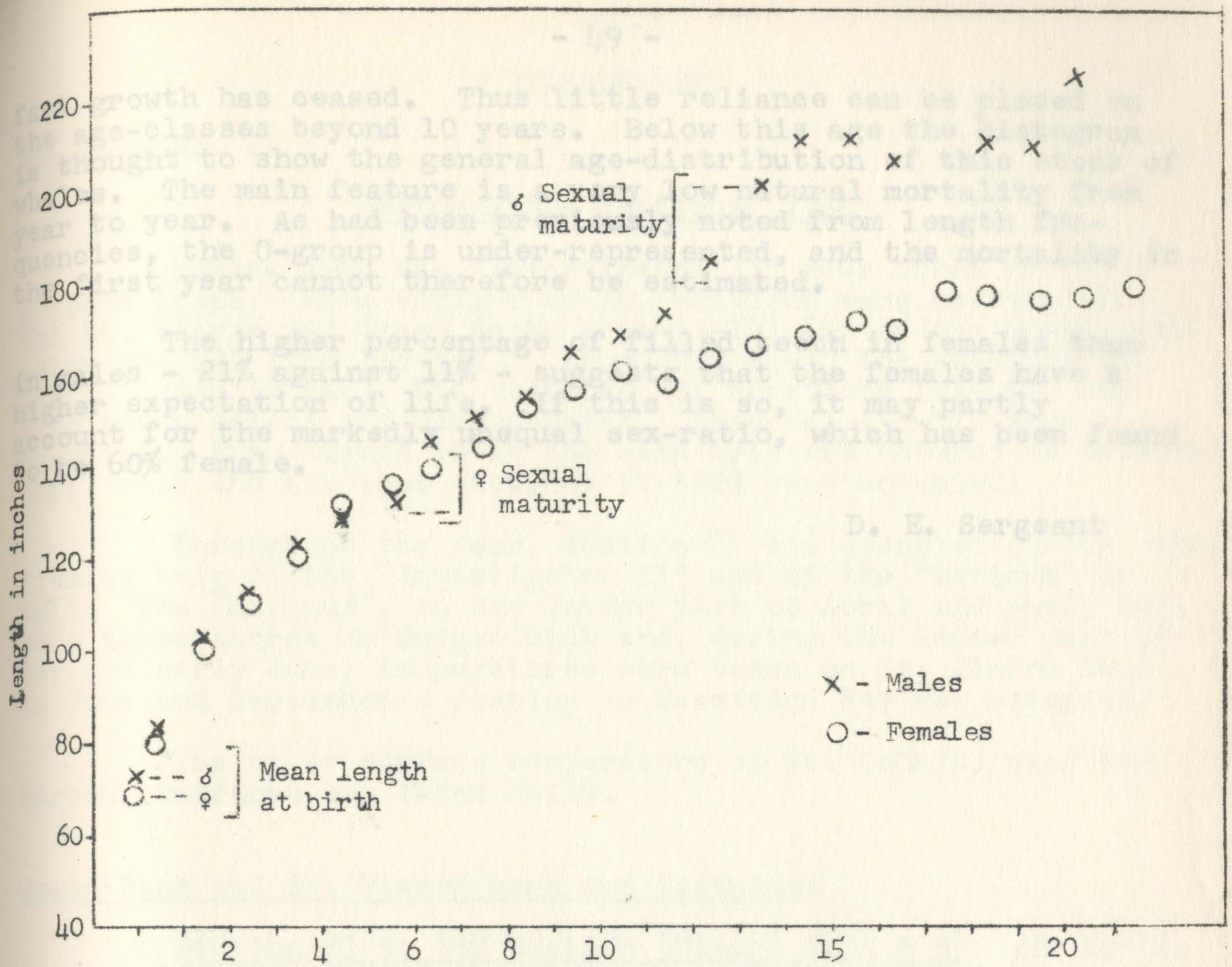


Figure 1. Absolute growth curve of pilot whales

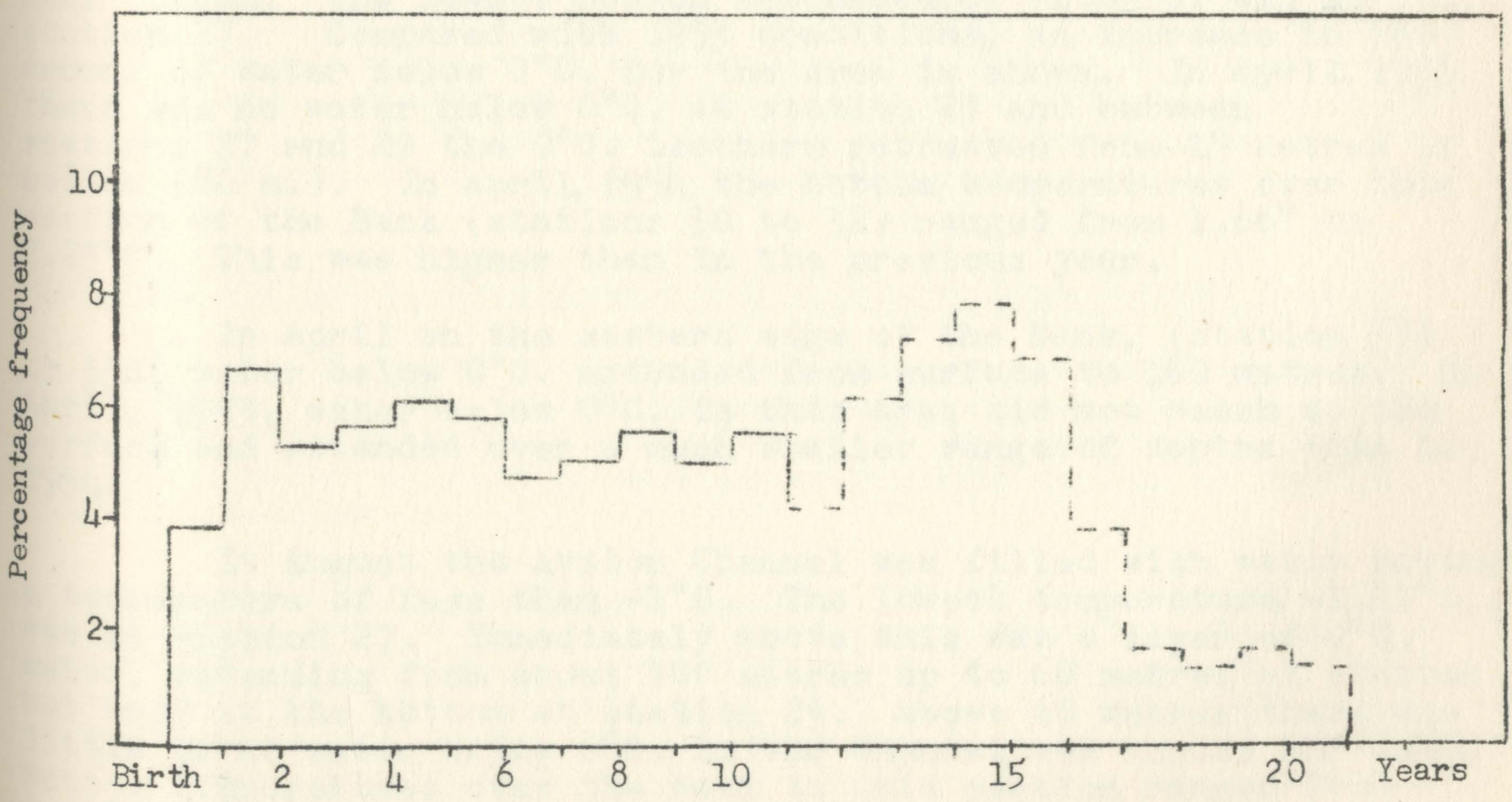


Figure 2. Age frequency of pilot whales. Sample of 360

fact growth has ceased. Thus little reliance can be placed on the age-classes beyond 10 years. Below this age the histogram is thought to show the general age-distribution of this stock of whales. The main feature is a very low natural mortality from year to year. As had been previously noted from length frequencies, the 0-group is under-represented, and the mortality in the first year cannot therefore be estimated.

The higher percentage of filled teeth in females than in males - 21% against 11% - suggests that the females have a higher expectation of life. If this is so, it may partly account for the markedly unequal sex-ratio, which has been found to be 60% female.

D. E. Sergeant

HYDROGRAPHY

Appendix No. 21

Hydrographic Sections, 1954

During 1954 the "Investigator II" made three hydrographic trips. From April 6 to 15, stations were occupied in the St. Pierre and Green Banks area (1-12) and on the Grand Bank below the 47° line (13-33E). From July 24-30 the stations on the 47° line (28-42), the stations off Bonavista (43-49), and also the stations off Domino Point, Labrador, (51-57) were occupied. From August 10-19 the same area was covered as between April 6-15 and the same stations (1-33B) were occupied.

Throughout the year, station 27 was occupied during each fishing trip of the "Investigator II" and of the "Marinus" as well. The "Marinus", in the latter part of April and early May, took temperatures on Burgeo Bank and, during the latter part of May and early June, temperatures were taken on St. Pierre Bank. In June and September a station in Hermitage Bay was occupied.

The water surface temperature at St. John's, near the harbour entrance was taken daily.

Grand Bank and St. Pierre Bank and Vicinity.

Station 27 to 33E Section (Figure 1, A & B). In April, water below 0°C. filled the whole channel from surface to bottom, from the coast to station 29, approximately 88 miles from the coast. A band of water below -1°C., at station 28, extended from surface to about 90 metres and at station 27 from 75 metres to near bottom. The lowest bottom temperature, -0.83°C. was at station 27. Compared with 1953 conditions, an increase in the amount of water below 0°C. for the area is shown. In April, 1953, there was no water below 0°C. at station 29 and between stations 27 and 29 the 0°C. isotherm retreated from 15 metres to bottom (80 m.). In April, 1954, the bottom temperatures over this section of the Bank (stations 30 to 32) ranged from 1.86° to 2.23°C. This was higher than in the previous year.

In April on the eastern edge of the Bank, (station 33A to 33E) water below 0°C. extended from surface to 160 metres. In April, 1953, water below 0°C. in this area did not reach to the surface and extended over a much smaller range of depths than in 1954.

In August the Avalon Channel was filled with water having a temperature of less than -1°C. The lowest temperature, -1.41°C., was at station 27. Immediately above this was a layer of 0°C. water, extending from about 100 metres up to 60 metres at station 27, but only at the bottom at station 29. Above 60 metres there was little or no water below 0°C. in the Channel and across the Bank. Bottom temperatures over the Bank in this section ranged from 0.38°C. (station 29) to 4.86°C. (station 32).

The cold water below 0°C. over the eastern edge of the Bank had diminished in bulk from April to August and did not extend out to station 33A. The lowest temperature recorded here was -0.85°C. at station 33 (50 metres). In comparison, the lowest temperature on the eastern edge in August, 1953, was -1.63°C. at station 33A (75 metres).

Stations 20B to 26G Section (Figure 1, C & D). The Channel between Green Bank and Grand Bank which had only a narrow band of -1°C. water in April was completely filled with it in August. Likewise, the 0° to -1°C. band of water immediately above this spread further across the Bank in August as far as station 21, as compared with station 20B in April, a difference of some 78 nautical miles. No temperatures below -1°C. were found on the southeastern edge of this Bank in August, and in April only a very small band existed about 50 nautical miles from the edge of the Bank, with a width of less than 7 nautical miles. However, the 0° to -1°C. water which was found only in the section over the edge of the Bank in April was in slightly over the eastern edge in August (station 26A).

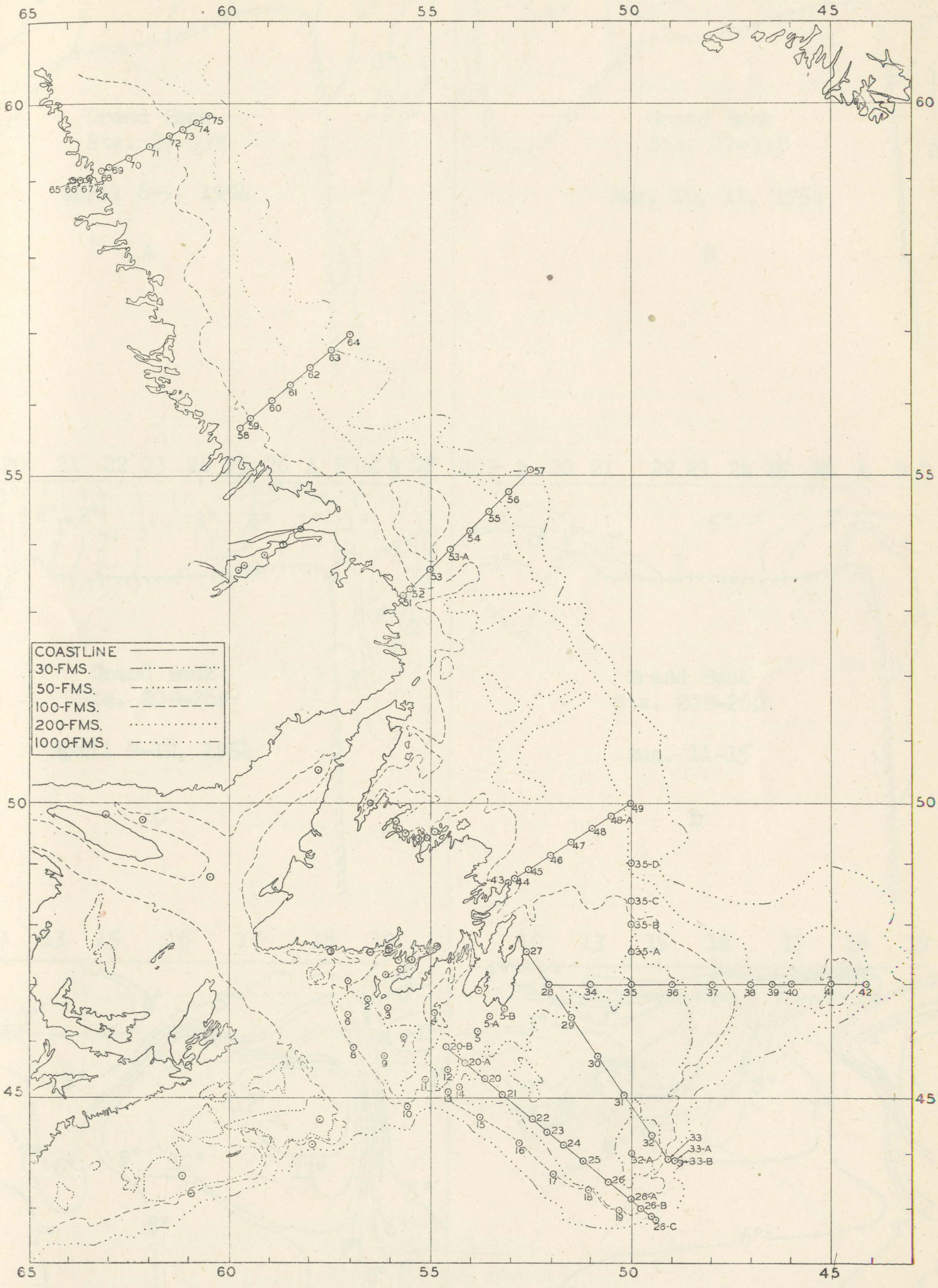
The bottom temperatures across the Bank (stations 22 to 26) were considerably higher in August than in April, varying from 2.5° to 5.9°C. in August and only from 1.0° to 3.2°C. in April.

S. W. Edge - Stations 11 to 19 (Figure 1, E & F). On the southwest edge of the Bank the highest temperature recorded in April was 12.98°C. (station 18, 150 m.) while that in August was only 8.21°C. (station 16, 150 m.), surface temperatures expected. The April temperatures were 3° to 4° higher on the average than comparable figures for 1953. Excluding station 19, the range of bottom temperatures was 6.7° to 9.5°C. in April and 4.3° to 6.4°C. in August; at station 19, the bottom temperature was -0.15°C. In April, the only water below 1°C. present in the section was at station 19 and it extended from a depth of 25 to 75 metres. In August, a temperature of 0.77°C. was recorded at station 18 (at 75 metres) and the cold water at station 19 extended from a depth of 50 to about 175 metres.

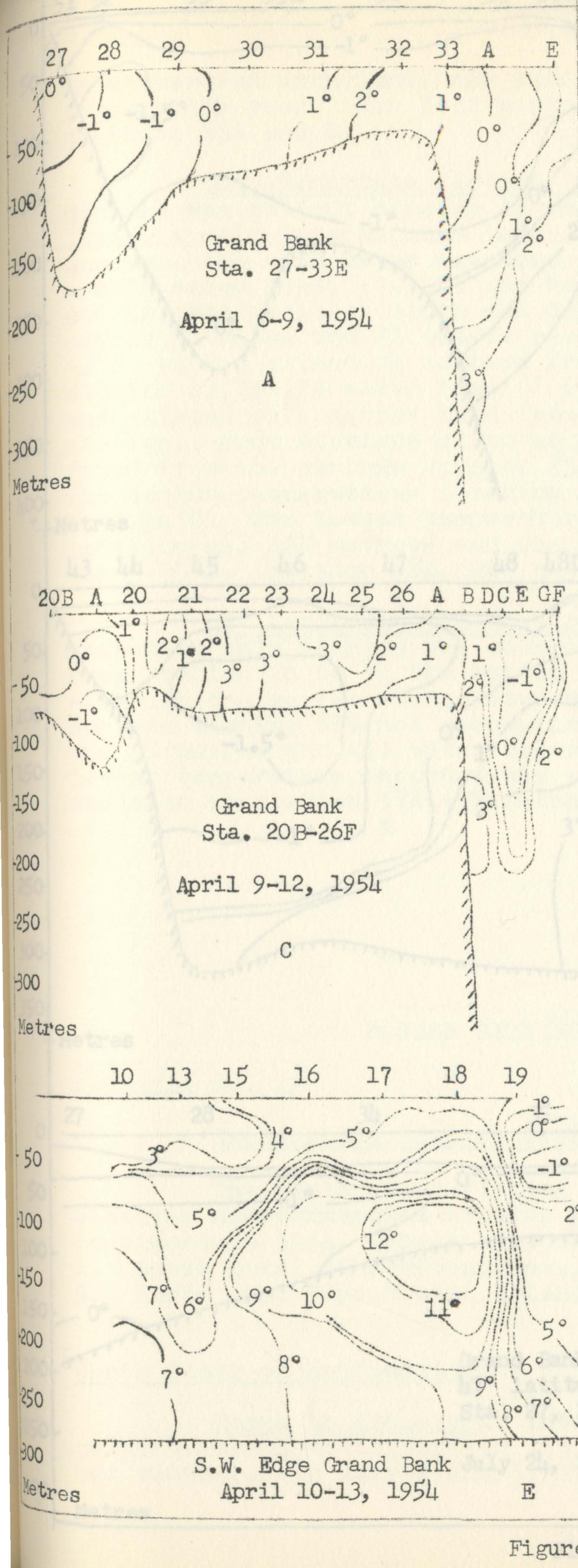
Southern Labrador, East Coast and Northern Bank Areas, Summer

The stations in these sections are occupied in summer each year during the second hydrographic cruise. In comparison with 1953, the bulk of water below -1°C. was greater in 1954, though no water of -1.5°C. and lower reached as far as the 47° latitude section.

Domino Point (Figure 2, A). The bulk of the water in this section was below -1°C., the lowest temperature being -1.65°C. at station 52 (75 metres), only 16 miles from the coast. The cross sectional area of this cold -1.5°C. water measured about 20 miles from the coast out and extended from 50 to 125 m. in depth.



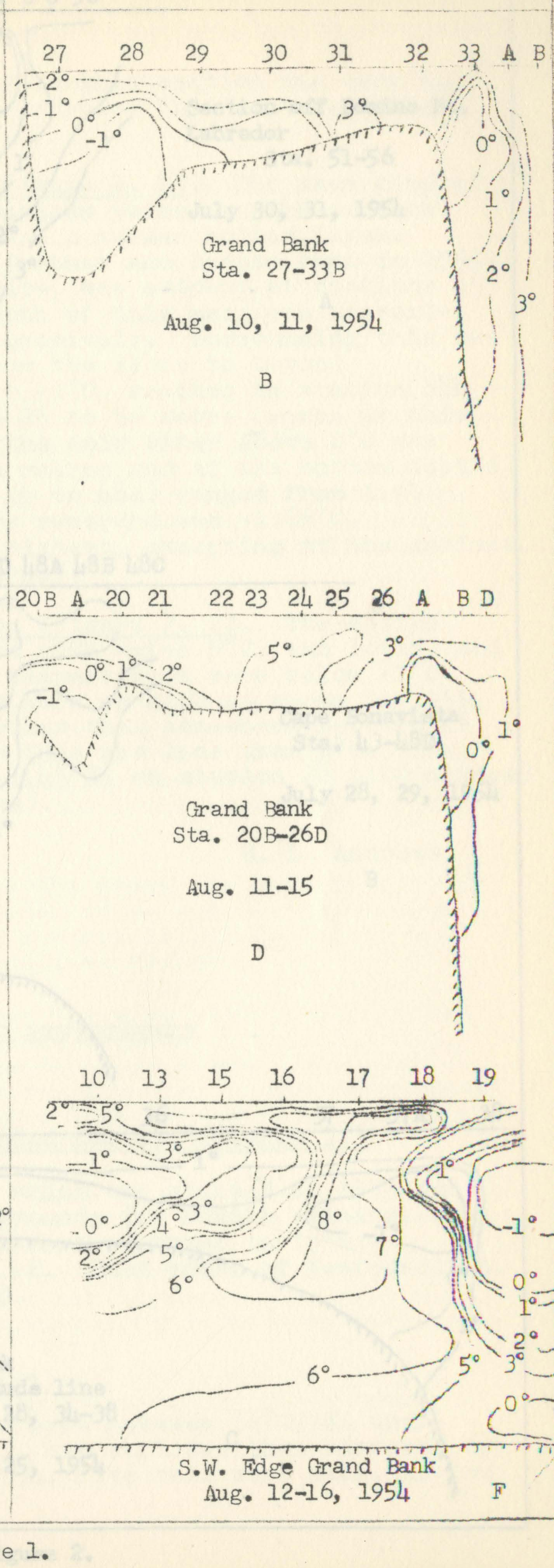
Hydrographic Stations



Grand Bank
Sta. 27-33E

April 6-9, 1954

A



Grand Bank
Sta. 27-33B

Aug. 10, 11, 1954

B

Grand Bank
Sta. 20B-26F

April 9-12, 1954

C

Grand Bank
Sta. 20B-26D

Aug. 11-15

D

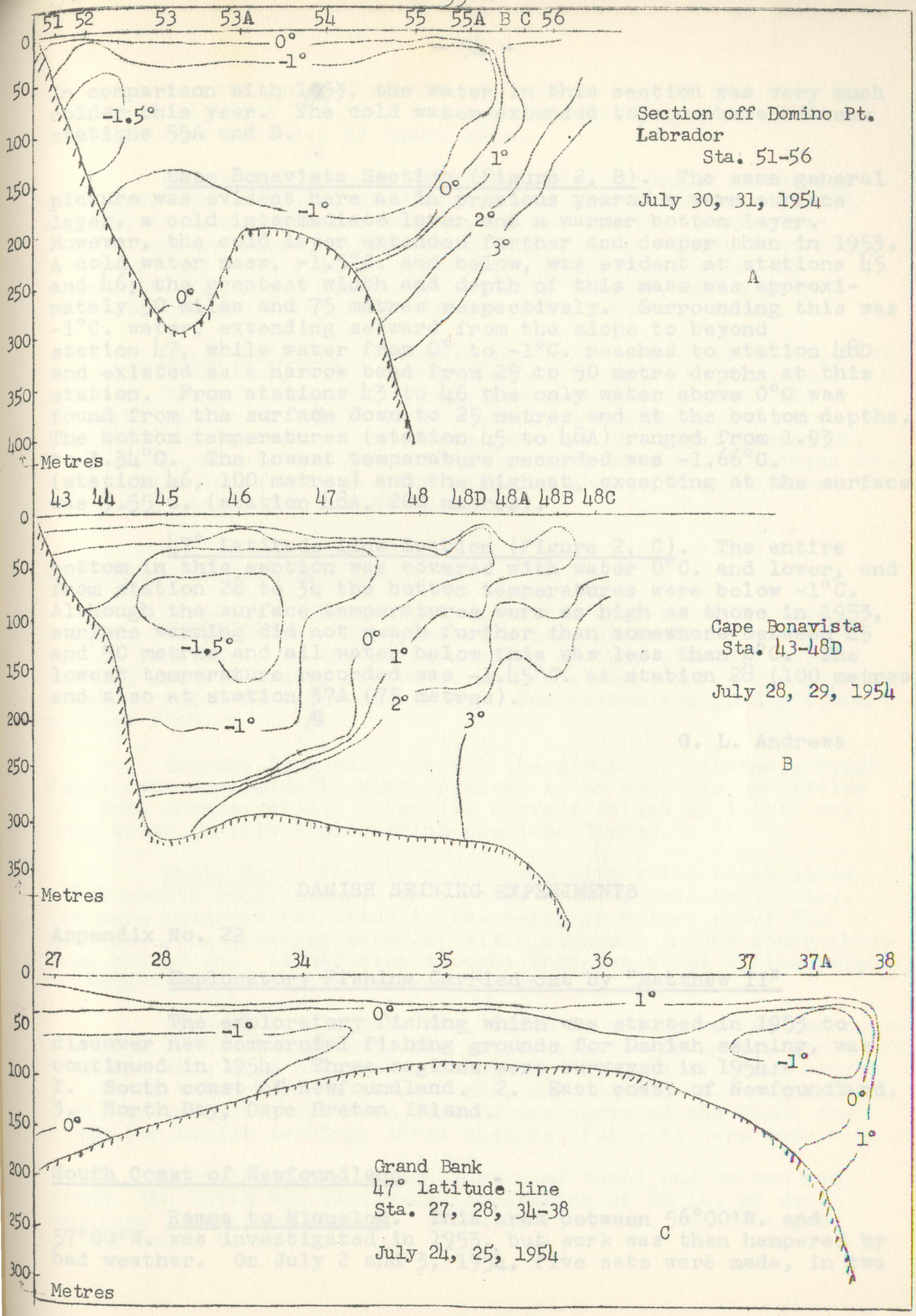
S.W. Edge Grand Bank
April 10-13, 1954

E

S.W. Edge Grand Bank
Aug. 12-16, 1954

F

Figure 1.



Section off Domino Pt.
Labrador
Sta. 51-56

July 30, 31, 1954

A

Cape Bonavista
Sta. 43-48D

July 28, 29, 1954

B

Grand Bank
47° latitude line
Sta. 27, 28, 34-38

July 24, 25, 1954

C

Figure 2.

In comparison with 1953, the water in this section was very much colder this year. The cold water extended to somewhere between stations 55A and B.

Cape Bonavista Section (Figure 2, B). The same general picture was evident here as in previous years: a warm surface layer, a cold intermediate layer and a warmer bottom layer. However, the cold layer extended farther and deeper than in 1953. A cold water mass, -1.5°C. and below, was evident at stations 45 and 46; the greatest width and depth of this mass was approximately 30 miles and 75 metres respectively. Surrounding this was -1°C. water, extending seaward from the slope to beyond station 47, while water from 0° to -1°C. reached to station 48D and existed as a narrow band from 25 to 50 metre depths at this station. From stations 43 to 46 the only water above 0°C was found from the surface down to 25 metres and at the bottom depths. The bottom temperatures (station 45 to 48A) ranged from 1.93 to 3.34°C. The lowest temperature recorded was -1.66°C. (station 46, 100 metres) and the highest, excepting at the surface, was 3.55°C. (station 48A, 200 metres).

47° Latitude Line Section (Figure 2, C). The entire bottom in this section was covered with water 0°C. and lower, and from station 28 to 34 the bottom temperatures were below -1°C. Although the surface temperatures were as high as those in 1953, surface warming did not reach further than somewhere between 25 and 50 metres and all water below this was less than 0°C. The lowest temperature recorded was -1.45°C. at station 28 (100 metres) and also at station 37A (75 metres).

G. L. Andrews

DANISH SEINING EXPERIMENTS

Appendix No. 22

Exploratory Fishing Carried out by "Matthew II"

The exploratory fishing which was started in 1953 to discover new commercial fishing grounds for Danish seining, was continued in 1954. Three regions were surveyed in 1954:-
1. South coast of Newfoundland. 2. East coast of Newfoundland. 3. North Bay, Cape Breton Island.

South Coast of Newfoundland

Ramea to Miquelon. This area between 56°00'W. and 57°00'W. was investigated in 1953, but work was then hampered by bad weather. On July 2 and 3, 1954, five sets were made, in two

of which suitable ground was found. Catches of 50 lb., average size 40.1 cm., and 120 lb., average size 39.07 cm., of witch flounder were produced by these sets.

Placentia Bay. In this bay, east of Burin Peninsula, five sets were made and good bottom was discovered between 115 and 130 fathoms. Catches between 70 and 500 lb. of American plaice were produced by four of the five sets. These fish were, however, small and a large proportion would be rejected in commercial fishing. Shallower water in this bay had a very rocky and uneven bottom. No deeper water could be found.

St. Mary's Bay. On July 12 one set was made in the bay; the gear hooked up, and a survey failed to show any more suitable ground. Owing to reports by longliners of good catches of American plaice on fairly level bottom, three more sets were attempted in September. On every occasion the ropes hooked up. Most of St. Mary's Bay has shallow water less than 50 fathoms deep, with a hard rough bottom. The sides of the one deep hole are too steep and uneven for Danish seining.

East Coast of Newfoundland

Offshore. The sea bottom on the east coast is very rugged. Offshore from Funk Island a deep channel extends north to 52° latitude. On the western slope of this channel, between the 165 and 210 fathom contours, six sets were made. The greatest catch of witch flounder was 12 lb. The bottom was good but there were no fish.

Inshore from this channel the ground is extremely rough. Three sets were made in what appeared to be smoother localities but were unsuccessful. Extensive surveys failed to locate any more areas in this region which could be fished.

White Bay. This is a deep bay with steep rocky sides and a smooth muddy floor. Of a total of five sets in the bay, two were unsuccessful owing to the depth of water, about 250 fathoms. The greatest catch of witch flounder in the other three sets was 10 lb. It had been thought that Greenland halibut might be caught here but only two were taken.

Green Bay. In this bay, which is a deep bay at the western side of Notre Dame Bay, the bottom was too irregular for a set. Two sets were made off the mouth of the bay; one of these caught 35 lb. of witch flounder; the other, on hard bottom, caught none. Level ground south of Horse Islands was surveyed and found too rough for Danish seining; three unsuccessful sets were made here.

Bonavista Bay. A small area of level mud bottom was found, the catch was very poor, consisting of 80 lb. of small American plaice and four lb. of witch flounder. No more good ground could be found.

Trinity Bay. This bay has steep rocky sides and a muddy bottom too deep for Danish seining. Two unsuccessful sets were made.

Conception Bay. The ground is very rough; one small area with soft bottom was found and a set yielded 50 lb. of American plaice and 50 lb. of small Greenland halibut.

North Bay, Cape Breton Island

North Bay is the name used by local fishermen for the arm of sea west of Cape Breton Island and east of the Magdalen and Prince Edward Islands. In this region, between 46°20'N. and 46°40'N., and 61°25'W. and 61°42'W., a large area of bottom suitable for Danish seining was found. Between depths of 32 and 37 fathoms five sets were made. All produced excellent results, with catches varying from 4000 to 9000 lb. consisting of witch flounder and American plaice.

The witch flounder catches were 1000 to 3000 lb. for each set; these fish were all large, the average length of fish for each set ranged from 48 to 54 cm. American plaice made up the bulk of the catches, as much as 7000 lb. to one set, and were mainly fish of a good commercial size. Small amounts of scrod and small market cod were also caught.

The good ground was situated on a bank, on the western side of a deeper channel which runs parallel with the Cape Breton coast. The bottom appeared to be very level and to consist of fine red sand. As the time available was limited the area could not be surveyed exhaustively, but fathometer recordings indicated good bottom in much of this region.

During one set farther north, at 46°55'N., 61°09'W., in the same depth, the gear caught on the bottom, which was rougher. A set in shallower water (20 fathoms) caught 300 lb. of yellowtail flounder and 100 lb. American plaice. The catch in over 50 fathoms was mainly witch flounder and American plaice, but the fish were smaller, (average length of witch flounder 47.4 cm.), and only totalled 900 lb. The bottom of the channel east of these grounds was too uneven to fish.

T. N. Stewart

LONGLINING

Appendix No. 23

Fishing Experiments, 1954

Introduction

Since 1950 the Station has been carrying out longlining experiments in Newfoundland waters, on behalf of the Department of Fisheries. In 1954 four Robar-type longlining boats were chartered for continuation of this work. These were the "Ada and Bill II", Capt. Hector Smith; "Atlantic Rover", Capt. Russell Decker; "Gertrude and Ronald", Capt. Gordon Hemeon; and "Pat and Judy", Capt. Joseph Atkinson. The "Ada and Bill II" is 51 ft. in length, the others 55 ft. The Captains were all experienced longline fishermen and each boat carried a crew of four including the Captain.

The "Atlantic Rover" and "Gertrude and Ronald" were chartered to fish commercially from Ramea Island from January 1 to April 15. This experiment was on a semi-commercial basis in that, while the catches remained the property of the Captains and crews, the Department of Fisheries paid all operating expenses of the boats.

These boats were also chartered to fish commercially from Bonavista from May 1 to 31. However, due to a fishermen's strike at this port, they could not fish from there during this period.

The "Ada and Bill II" and "Gertrude and Ronald" were chartered from June 1 to October 31 to fish on a commercial basis from Badger's Quay. As the object of this experiment was to show that the grounds in the western half of Bonavista Bay and north to Funk Island could be successfully fished by longlining boats operating from Badger's Quay, the Captains were instructed not to fish south of a line drawn from Barrow Harbour, Bonavista Bay, to a point 49°24'N., 52°20'W. This ensured that they did not fish the grounds normally fished by the Bonavista longlining fleet.

From June 1 to October 30, the "Atlantic Rover" and "Pat and Judy" carried out experimental fishing on the east and south coasts. Between June 9 and July 3 they explored the deep-water offshore grounds in Bonavista Bay and north to the Funk Island area. They used Badger's Quay as a base for this operation. On July 4 they moved to Twillingate and from there, using La Scie as a secondary base, explored possible longlining grounds within sixty miles of La Scie and Twillingate. The Bonavista Bay-Funk Island and Twillingate-La Scie areas were partially explored in 1952, and this year the boats concentrated on grounds in these areas which were not fully covered during those explorations.

On September 2 the boats proceeded south and, using Fermeuse, St. Mary's and Trepassey as bases, fished inshore grounds from Ballard Bank west to Cape St. Mary's. Capt. Atkinson became ill on October 12 and the "Pat and Judy" finished fishing on that day. The "Atlantic Rover" continued fishing until October 29.

These boats fished large ranges of depths in all areas but concentrated on depths which, on the basis of previous experience and prevailing hydrographic conditions, were expected to yield good catches.

Catches were sold whenever possible but the sale of fish was not allowed to interfere with any of the experiments.

The standard gear used by the boats consisted of tubs of twelve fifty-fathom lines with hooks six feet apart.

Squid was used for bait in all the experiments except for a period during the experimental fishing in the Twillingate-La Scie area when capelin was the only available bait.

Commercial Experiment, Ramea, January 15 to April 14, 1954

The "Gertrude and Ronald" arrived at Ramea on January 15; the "Atlantic Rover" was delayed in arriving until January 24 when the first trip by both boats was made. From January 15 to 24, weather was unsuitable for fishing.

Weather conditions were very poor throughout the experiment and the boats made relatively few trips. However, they fished large amounts of gear on days which would be normally considered too stormy for fishing, and there is no doubt that similar boats operating commercially could not have shown a greater fishing effort in the prevailing conditions.

Fish Catches. Table I summarizes the fishing effort and catches of the two boats and gives the landed values of their catches. Totals were computed in dollars and cents and apparent irregularities are due to rounding off to the nearest dollar.

Cod catches were low in all areas throughout the experiment. The best catches were on the northern and western edges of Burgeo Bank in March, averaging 600 lb. per tub. In January and February they averaged only 390 lb. per tub and in April 420 lb. per tub on these grounds. On the inshore grounds, within ten miles of Ramea, they were low throughout the period, averaging from 300 to 360 lb. per tub in the four months. On Banquereau Bank (the name given locally to the small bank situated between Burgeo Bank and Ramea) catches averaged 370 lb. per tub in February, 415 lb. in March and 200 lb. in April. On Grey River Bank the cod catches averaged 390 lb. per tub in March and 480 lb. in April.

Table I

Summary of Fishing Effort and Catches and Catch Values at Ramea January 24-April 14, 1954

	"Atlantic Rover"				"Gertrude & Ronald"			
	January 24-31	February	March	April 1-14	January 24-31	February	March	April 1-14
No. of trips	3	12	13	6	3	14	12	6
Total hours at sea	27	129	147	83	28	149	143	85
Total tubs gear fished	15	75	98	52	15	82	85	56
Lb. cod per tub gear	279	362	446	392	333	382	509	410
Lb. commercial fish per tub gear	304	404	472	459	377	435	544	458
Fish Catches lb.								
Cod	4,183	27,121	43,683	20,385	4,989	31,348	43,223	22,984
Halibut	-	102	162	349	-	82	284	257
Haddock	322	2,096	1,657	2,239	490	3,388	1,938	1,684
Plaice	-	2	4	10	-	-	-	-
Redfish	-	458	436	662	173	408	451	637
Wolffish	53	548	352	236	8	417	216	91
Total Marketable Fish	4,558	30,327	46,294	23,881	5,660	35,643	46,112	25,653
Catch Value to Nearest $								
Cod	105	678	1,092	510	125	784	1,078	575
Halibut	-	15	24	52	-	13	43	39
Haddock	10	68	54	73	16	78	63	55
Plaice	-	-	-	-	-	-	-	-
Redfish	2	9	9	13	3	8	9	13
Wolffish	1	16	11	7	-	13	6	3
Total Value of Catch	118	787	1,190	655	144	894	1,200	683

The greatest number of trips (26) was to the inshore grounds which could be fished on days unsuitable for offshore fishing. Twenty-four trips were made to Burgeo Bank (17 of which were in March and April), fourteen to Banquereau Bank and five to Grey River Bank in March and April. Ten of the trips to Banquereau Bank were made in February.

The best cod catches were consistently made in depths of 60 to 85 fathoms in all areas, but with the exception of Burgeo Bank, the Captains found great difficulty in keeping their gear in these depths. On the inshore grounds, Banquereau Bank and Grey River Bank, the shoal water areas are small and very irregular.

Fish other than cod made up 9% by weight of the total catch (15% value) and of this 9%, two-thirds consisted of haddock. Very few plaice were caught and wolffish catches were much lower than in the experimental fishing in this area in May and June, 1953.

The fishing intensity steadily increased during the experiment as the lengthening period of daylight allowed more gear to be fished. The Captains always finished fishing in time to reach Ramea Harbour before dark, as stormy weather and frequent heavy snow showers often reduced visibility to almost zero. The boats fished an average of 5 tubs of gear per trip in January, 6 in February, 7½ in March and 9 in April. The greatest amount of gear fished by either boat in one day was 10 tubs.

In January three local Jack boats were longlining from Ramea, setting and hauling their gear from dories, but by early March two had stopped fishing and the third made only six trips in March. Throughout the experiment these boats fished many days less than the chartered boats (the result of their method of fishing and the extremely bad weather) and consistently caught less fish per comparable amount of gear.

Economics of the Boats' Operations. Table II gives the income and operating costs of the two boats and also shows the normal method of dividing the income and expenses.

With a local crew, the cost of food would be much lower (say $10 per month per person) and the operating costs could be reduced if the crew did not live aboard (mainly by eliminating the cost of fuel for heating and lighting the living quarters). Accepting a reduction of 10% (which is high) on operating costs and the lower cost of food, in this experiment the crewman's share on the "Atlantic Rover" would increase to $147 and on the "Gertrude and Ronald" to $194. The boats' shares would not be increased as they are based on the gross value of the catch.

These increased crewmen's shares are still far below the minimum required to retain a crew for a three-month period, and the boats' shares are below the minimum amount required to operate such boats successfully for a similar period.

Table II

Income and Expenditure

	Atlantic Rover (Jan. 24-Apr. 14)		Gertrude and Ronald (Jan. 15-Apr. 14)	
Total Gross Stock		$2750		$2921
Operating Expenses excluding Food				
-Engine Costs	$656		$634	
-Bait	354		369	
-Fishing Gear	414		348	
-Miscellaneous	98	$1522	89	$1440
Food estimated at $40 per month per person		$ 425		$ 480
Total Expenses		$1947		$1920
Net Earnings Boat and Crew		$ 803		$1001

Under Normal Operating Conditions

Operating Expenses	$1947	$1920
Boat Share 25% of Gross	688	730
Total Expenses	2635	2650
Net Income of Crew	115	271
Crew man Share	29	68

Burgeo Bank is too distant to be fished constantly even in milder winters, and the low catches on the inshore grounds and "Banquereau Bank" (the grounds most easily fished from Ramea) would prevent similar boats from obtaining much greater catches in milder winters, when they could fish more days than was possible in this experiment.

Thus, it is improbable that the operation of this type of boat from Ramea, in the winter months, could be a financial success.

Commercial Experiment Badger's Quay June 1 to October 12, 1954

The "Gertrude and Ronald" began fishing operations on June 1, but the "Ada and Bill II" was delayed enroute by stormy weather and drift ice in Bonavista Bay, and did not arrive at Badger's Quay until June 8.

The experimental longline fishing in 1952 showed the deep-water grounds off Funk Island to be the best longlining grounds for cod, as yet found off the Newfoundland coast.

However, excellent cod catches were obtained, from June to September, on grounds 19 to 25 miles E. x S. of Badger's Quay and the boats did not make any trips to the Funk Island grounds. From September 11 to October 12 the boats fished inshore, shoal-water grounds 3 miles N.E. of Cabot Island.

Bait was obtained from the bait freezer at Greenspond and, as the boats normally harboured at Badger's Quay (and until late September were landing their catches there) they had to collect bait from Greenspond enroute to or from the fishing grounds. Greenspond, which is five miles from Badger's Quay, has a poor harbour and the boats rarely harboured there. If bad weather prevented the boats from fishing, any gear already baited had to be taken to the cool room at Greenspond for storage.

The Captains arranged to have part of their gear baited by shore labour.

Fish Catches. Tables III and IV give summaries of the fishing effort and catches of the "Ada and Bill II", from June 9 to October 12, and "Gertrude and Ronald", from June 1 to October 12, respectively. The Tables also give the landed values of their catches on the basis of the following prices: cod 2¢ per lb. head on, gutted; wolffish 3¢ per lb. head on, gutted; halibut 10¢ per lb. head off, gutted; and plaice and redfish 2¢ per lb. round.

Cod catches were excellent throughout the experiment. On the offshore grounds the "Gertrude and Ronald" averaged 1382 lb. per tub in June, almost 2000 lb. per tub in July and August and 1517 lb. per tub in September. On the inshore grounds this boat averaged 1623 lb. per tub in September and 1466 lb. in October.

The "Ada and Bill II" averaged 1348 lb. per tub in June, almost as much as the "Gertrude and Ronald", but from July onward consistently averaged about 300 lb. per tub less than the "Gertrude and Ronald", and had a total catch for the period over 250,000 lb. less than the "Gertrude and Ronald".

Small amounts of wolffish, plaice, Greenland halibut, halibut and redfish were caught on the offshore grounds but never amounted to more than 10% of the total catch on any set. On the inshore grounds, plaice was the only other commercial fish caught.

The depths fished on the offshore grounds ranged from 107 to 185 fathoms, but the usual range, in which the best catches were made, was 125 to 150 fathoms. On the inshore grounds, the depths ranged from 7 to 44 fathoms with the best catches being obtained in 20 to 35 fathoms. Very few bottom temperatures were taken, as the boats were fishing commercially. From the few taken it was evident that offshore the boats were fishing at the junction of the bottom of the cold (below 0°C.) water layer always present off this coast, and the deeper warm (above 0°C.) water. Inshore they were fishing above and just into the upper part of this cold water layer.

Table III

Fishing Effort and Catches "Ada and Bill II" June 9 to October 12, 1954

	June 9-30	July	August	September		October 1-12	Total
Number of trips	9	14	13	15	(4)	4	55
Total hours at sea	136	245	221	212	(70)	54	868
Total tubs gear fished	59	108	91	111	(27)	28	397
Lb. cod per tub gear	1,348	1,623	1,684	1,250	(1,359)	937	-
Fish Catches lb.							
Cod	79,548	175,318	153,250	138,803	(36,717)	26,244	573,163
Wolffish	889	1,805	2,495	1,520	(1,520)	-	6,709
Plaice	800	1,625	926	3,085	(312)	510	6,946
Halibut	-	170	260	-		-	430
Redfish	7	-	12	-		-	19
Total Marketable Fish	81,244	178,918	156,943	143,408	(38,549)	26,754	587,267
Catch Value to nearest $							
Cod	1,591	3,506	3,065	2,776		525	11,463
Wolffish	21	43	60	36		-	160
Plaice	16	33	19	62		10	140
Halibut	-	12	20	-		-	32
Redfish	-	-	-	-		-	-
Total Value of Catch	1,628	3,594	3,164	2,874		535	11,795

Figures in brackets for September give the fishing effort and catches on the offshore grounds.

Table IV

Fishing Effort and Catches "Gertrude and Ronald" June 1 to October 12, 1954

	June 1-30	July	August	September		October 1-12	Total
Number of trips	12	19	17	13	(4)	4	65
Total hours at sea	186	326	289	197	(70)	51	1,049
Total tubs gear fished	81	146	125	99	(29)	31	482
Lb. cod per tub gear	1,382	1,937	1,906	1,592	(1,517)	1,466	-
Fish Catches lb.							
Cod	111,917	282,786	238,202	157,640	(43,991)	45,443	835,988
Wolffish	1,370	2,729	5,361	2,055	(2,055)	-	11,515
Plaice	995	2,440	1,810	2,155	(840)	680	8,080
Halibut	60	252	192	30	(30)	-	534
Redfish	10	-	12	-		-	22
Total Marketable Fish	114,352	288,207	245,577	161,880	(46,916)	46,123	856,139
Catch Value to nearest $							
Cod	2,238	5,656	4,764	3,153		909	16,720
Wolffish	33	66	129	50		-	277
Plaice	10	49	36	43		14	152
Halibut	5	19	14	2		-	40
Redfish	-	-	-	-		-	-
Total Value of Catch	2,286	5,790	4,943	3,248		923	17,189

Figures in brackets for September give the fishing effort and catches on the offshore grounds.

Table V

Economics of the Longlining Boats, Badgers Quay, June to October, 1954

	Month	Gross Stock $	Boat's Share $	Expenses $	Net Stock $	Share per Man $
"Ada and Bill II"	June 9-30	1,591	318	560	712	178
	July	3,506	701	779	2,026	506
	August	3,065	613	878	1,574	393
	September	2,776	555	888	1,333	333
	October 1-12	525	105	166	254	64
	Total	11,463	2,292	3,271	5,899	1,474
"Gertrude and Ronald"	June 1-30	2,238	560	708	970	243
	July	5,656	1,414	977	3,265	816
	August	4,764	1,191	1,149	2,424	606
	September	3,153	788	694	1,671	418
	October 1-12	909	227	163	519	130
	Total	16,720	4,180	3,691	8,849	2,213

Economics of the Boats' Operations. Table V summarizes the economics of the boats' operations. The gross stock is based only on the value of the cod landed (see Tables III and IV) at a price of 2¢ per lb. head on, gutted. Values are given to the nearest dollar. The "Ada and Bill II" took 20% of the gross stock for the boats' share, the "Gertrude and Ronald" 25%.

The smaller boat-share taken by the "Ada and Bill II" resulted in a proportionately higher crewman's share (in relation to the gross value of the catch), which averaged $347 per month for the period of 4 1/4 months. On the "Gertrude and Ronald" the crewman's share averaged $492 per month for the 4½ month period. This is a very high rate of income and is much higher than that of the average inshore fisherman on this coast.

There is no doubt that longlining boats could operate successfully from Badger's Quay if they could obtain a minimum of 2¢ per lb. for head-on, gutted cod. The offshore and inshore grounds are extensive and could support a large fleet of boats.

Longlining Experimental Fishing East and South Coasts, June-October, 1954

As the previous longlining experiments on the east coast have shown, the good longlining grounds for cod in the deep-water offshore areas are at depths where the bottom temperature ranges from approximately -0.5 to over 1.0°C., i.e. at the junction of the bottom of the cold (below 0°C.) water layer always present off this coast and the deeper warm (above 0°C.) water. Consequently in the Bonavista Bay-Funk Island and Twillingate-La Scie areas, the boats fished mainly at depths with the above range of temperatures.

In the areas fished on the south coast, the main fishing effort was in shoal water in depths above, and extending into, the top of the intermediate cold layer where bottom temperatures ranged from above 1.0 to -0.5°C. There are no deep water areas (below 100 fathoms) off this section of coast, and the entire bottom below approximately 40 fathoms is covered by the cold water layer, with temperatures as low as -1.7°C. There is a small isolated area of water below 100 fathoms in St. Mary's Bay but very little cold water extends into this bay, and bottom temperatures in this deep water were above -0.5°C.

Fish Catches. Figure 1 shows the position and average cod catch per tub of all the sets made. Table VI summarizes the fishing effort and catches of the boats in the various areas. In the Table, all sets in which the gear was fished in deep water with bottom temperatures above -0.5°C. are termed deep; those in depths with bottom temperatures below -0.5°C., intermediate; and those in shoal water with temperatures above -0.5°C., shoal. There was, of course, some overlap between the shoal and deep categories and the intermediate one, but, in the Table, sets which extended from warm water above 0°C. into cold water below -0.5°C were placed in the deep or shoal categories depending on the depths fished.

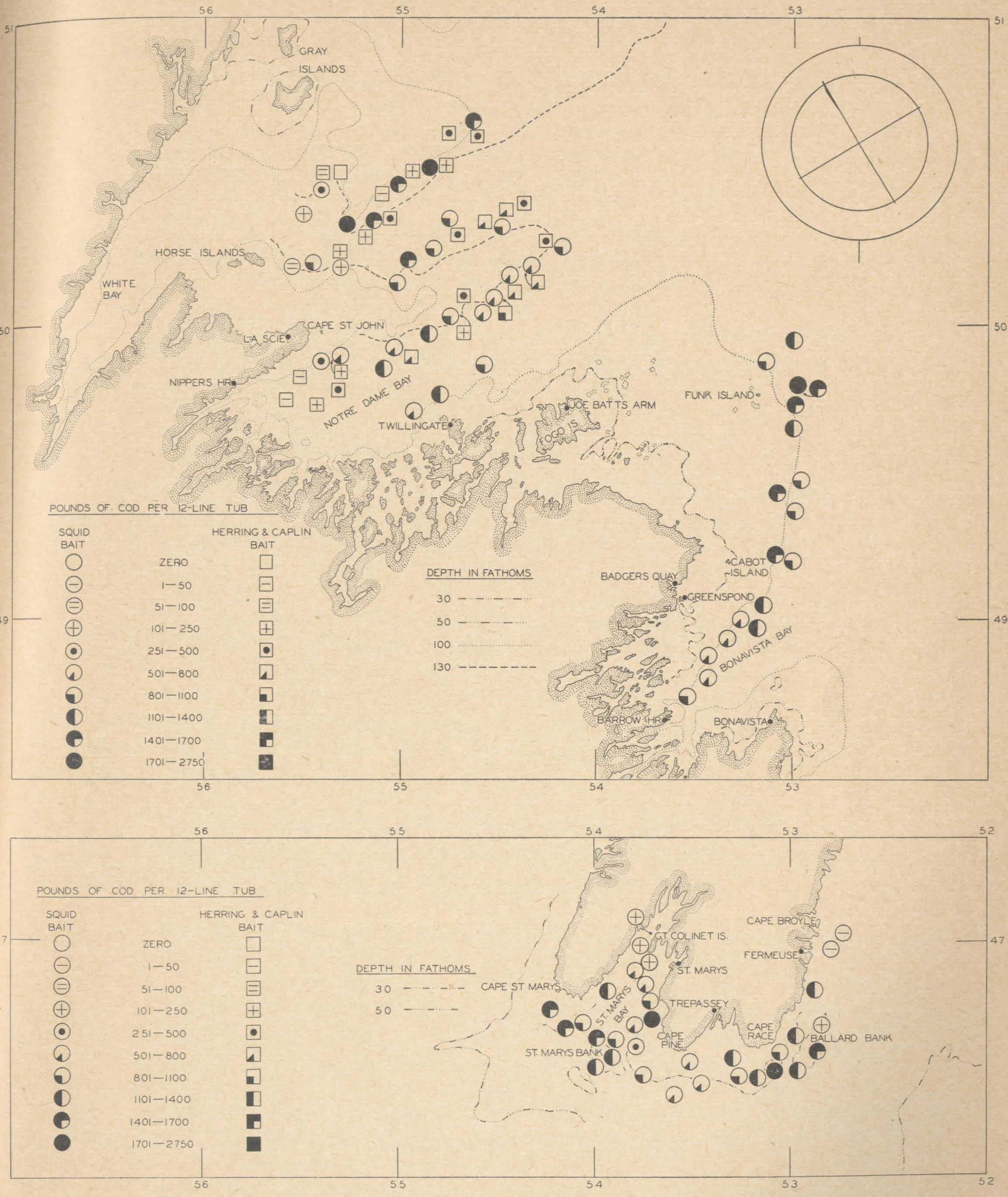


Figure 1. Cod Catches Longlining Experiments East and South Coasts Newfoundland, June - October, 1954

a. Bonavista Bay-Funk Island Area. In Table VI, the sets have been divided into two areas, Bonavista Bay and Funk Island areas. The area north of 49°40'N. is considered the Funk Island area.

In the Bonavista Bay area cod catches were good, averaging 900 lb. per tub. The best catches were in the northern half of the area. On the sets made in the southern half of the Bay, the gear set below 155 fathoms was often covered in slime and very few cod were caught on such gear.

In the Funk Island area, the cod catch per tub was high, averaging 1500 lb. per tub on all the sets, and the lowest individual catch on any one set was 1000 lb. per tub.

In the Bonavista Bay area the best cod catches were in depths of 130 to 155 fathoms, and in the Funk Island area in slightly deeper water.

b. Twillingate-La Scie Area. From July 4 to August 1 the only available bait was frozen capelin and cod catches in this period were low, averaging only 385 lb. per tub on the deep sets. The best catches (up to 850 lb. per tub) with this bait were obtained on the southeast edge of the bank which extends east from Cape St. John.

In August, with squid bait, cod catches were much higher on all the grounds fished. Excellent catches (1500 to 2000 lb. per tub) were obtained along the southern edge of the bank which extends south from the Grey Islands. Good to excellent catches were obtained along both sides of the bank which extends east from Cape St. John, with the best catches being made on the western half of the bank.

Cod catches in Notre Dame Bay and in the deep water west of the bank which extends south from the Grey Islands were low on all sets, with both squid and capelin as bait.

Moderate to good cod catches were obtained on squid bait, in the deep water within 8 to 15 miles of Twillingate.

The best cod catches were generally obtained in depths of 120 to 160 fathoms, the best fishing depths varying during the experiment and in the different areas fished.

Cod catches were in general lower than in the experimental fishing carried out in this area in 1952.

c. St. Mary's-Trepassey Area. Cod catches were excellent in almost all the sets made in this area in depths of 20 to 45 fathoms. The best catches were obtained on Ballard Bank, the grounds off Cape Race and on St. Mary's Bank.

Several sets were made in deep water (55 to 112 fathoms) in St. Mary's Bay and catches on these sets were low, ranging

Table VI

Summary of Catches and Effort of Experimental Longliners, East and South Coasts, 1954

	Bonavista Bay	Funk Island Area[x]	Twillingate Area Caplin Bait		Twillingate Area Squid Bait		St. Mary's Bay Area	
	Deep	Deep	Intermediate	Deep	Intermediate	Deep	Shoal	Intermediate
No. of trips	13	6	4	22	1	28	31	2
Total hours at sea	165	97	55	299	8	339	307	15
Total tubs gear fished	52	25	12	88	2	104	115	4
Range of depths - faths.	109 to 178	113 to 200	111 to 140	110 to 195	120 to 120	113 to 198	9 to 112	91 to 102
Range of temperature - °C.	-1.0 to 1.2	-0.9 to 1.0	-0.4 to -1.3	-0.6 to 1.7	-1.1 to -1.1	-0.8 to 1.4	-1.4 to 6.8	-0.9 to -1.4
Fish Catches, lb.								
Halibut	6	-	4	80	-	5	-	-
Haddock	-	-	-	-	-	-	36	-
Plaice	195	104	98	737	30	678	8,665	2
Redfish	-	4	-	-	-	-	-	-
Wolffish	225	105	-	375	-	223	-	-
Greenland Halibut	370	445	48	1,733	-	1,116	12	-
Cod	47,265	36,494	1,005	33,856	335	103,928	117,809	75
Lb. cod per tub gear	909	1,460	84	385	168	999	1,024	19

[x]North of 49°40'N.

from 190 to 800 lb. per tub. The lowest bottom temperature in this Bay was -0.3°C. Two sets were made in intermediate water off Fermeuse and as was expected, cod catches on these sets were almost nil.

There were many banking schooners and draggers operating in this area in October, and on several occasions the experimental boats could not set their gear in the best range of depths because of the presence of these commercial boats, resulting in below average cod catches on these sets. The grounds off Cape Pine had been intensively fished by draggers and cod catches on sets made on these grounds were low.

Wolffish, Greenland halibut, plaice and halibut were caught in the Bonavista Bay-Funk Island and Twillingate-La Scie areas, but never in large amounts in any one set. In the areas fished on the south coast the only commercial fish, other than cod, caught in quantity was plaice. Catches of 100 to 450 lb. of plaice per tub were obtained on some sets in St. Mary's Bay and on St. Mary's Bank.

The results of the experimental fishing carried out on the east coast this year do not alter the assessments of ports, and their suitability as centres for longline fishing, made in the 1952 Annual Report of this Station.

Cod Sizes in Longlining Catches.

Table VII shows the cod sizes in the longlining catches in 1954. The sizes were first arranged in 5 cm. groups before the calculations on which the Table is based were made, and, while the percentages of baby, scrod, market and large are approximate, the differences from the true figures are not great. Lengths were taken from the tip of the snout to the mid-fork of the tail, weights are of fish gutted and gilled.

In the Ramea area there was no significant difference in the sizes of cod caught on the offshore and inshore grounds, and sizes were similar to those caught in this area in May and June, 1953.

There was a marked and regular increase in the average length and weight of the cod and in the percentage weight of large (over 10 lb.) cod caught on the offshore grounds in Bonavista Bay from June to September. In September, the cod averaged 4.2 inches longer and 2.8 lb. heavier than those caught in June, and large fish made up almost half of the total weight of cod caught. In June, large fish made up only 11.4% of the total weight. The cod caught on the inshore grounds in Bonavista Bay in September and October were much larger and heavier than the usual inshore trap- and line-caught fish, but were smaller than those caught on the offshore grounds in the Bay in September.

Table VII

Sizes and Weights of Cod Caught by the Chartered Longlining Boats, 1954

	Bonavista Bay						Funk Island Area	Twillingate La Scie Area	St. Mary's-Trepassey Area
	Offshore					Inshore			
	Jan.-April	June	July	Aug.	Sept.	Sept.-Oct.	June-July	July-Aug.	Sept.-Oct.
Total cod measured	7,387	2,677	8,825	11,038	2,706	9,954	1,163	12,061	4,450
% 31-40 cm. 12.2-15.7 in. (Baby)	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
% 41-55 cm. 16.1-21.7 in. (Scrod)	32.8	12.4	7.3	3.3	2.2	7.2	1.6	7.8	7.4
% 56-85 cm. 22.0-33.5 in. (Market)	60.9	83.6	77.9	72.7	70.8	83.4	93.0	87.7	74.8
% 86-145 cm. 33.9-56.1 in. (Large)	5.2	4.0	14.8	24.0	27.0	9.4	5.4	4.5	17.7
% weight Below $1\frac{1}{2}$ lb. (Baby)	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
% weight $1\frac{1}{2}$-$2\frac{1}{2}$ lb. (Scrod)	16.0	5.6	2.8	1.1	0.7	3.0	0.6	3.7	2.5
% weight $2\frac{1}{2}$-10 lb. (Market)	65.6	83.0	65.4	57.6	55.6	75.7	87.8	83.4	61.3
% weight Over 10 lb. (Large)	18.2	11.4	31.8	41.3	43.7	21.3	11.6	12.9	32.2
Average length, in.	24.3	26.3	27.9	29.8	30.5	27.3	28.1	26.1	28.3
Average length, cm.	61.8	66.9	70.9	75.6	77.5	69.3	71.3	66.4	72.0
Average gutted and gilled weight, lb.	4.2	4.9	6.0	7.2	7.7	5.5	5.8	4.9	6.0

The cod caught in the Funk Island area were larger than those caught on the Bonavista Bay offshore grounds in the same period, but were smaller than those caught on the latter grounds in August and September.

There was little variation in the sizes of the cod caught on the various grounds in the Twillingate-La Scie area. The cod caught in this area during the 1952 longline experimental fishing were a little larger than those caught in the 1954 experiment.

The cod caught in the St. Mary's-Trepassey area were large averaging 28.3 inches in length and 6.4 lb. in weight. On some sets, the average length and weight of the cod caught were much smaller and in this area there was a partial segregation at least of large and small fish. The small cod tended to be in shoal warm water and the large fish in deeper colder water.

Baby cod (below $1\frac{1}{2}$ lb.) were caught in negligible amounts and scrod ($1\frac{1}{2}$ to $2\frac{1}{2}$ lb.) made up only a small percentage of the total weight of cod caught, in all the areas fished.

H. D. Macpherson

NEWFOUNDLAND TECHNOLOGICAL UNIT

Appendix No. 24

Engineering Services Etc.

Historical Review

The Engineering Service of the Fisheries Research Board of Canada was extended to Newfoundland early in 1950 at which time Mr. R. P. Hunt, a mechanical engineer, was engaged by the Atlantic Fisheries Experimental Station to carry on the engineering work of that Station in the Province of Newfoundland. During the summer of 1950, R. P. Hunt, accompanied by M. A. Foley of the Halifax Station, made an extended tour of the fish plants in Newfoundland to become acquainted with the plants and the personnel of the industry and to make known to the industry that the Fisheries Research Board of Canada provided an advisory Engineering Service. The industry made many requests for information on smoking and drying which led, eventually, to the installation of several smokers and dryers.

Mr. Hunt assisted several firms in the installation of Atlantic Fisheries Experimental Station type dryers for the processing of heavily salted fish, all of which are still in operation and are turning out good quality fish. One firm, without informing the Fisheries Research Board, constructed a small plant for processing lightly salted fish. Two A.F.E.S. type dryers were

installed, together with cool room and other facilities. Lightly salted fish was moved to the plant from the stages of fishermen in the salt bulk state. Some fish spoiled in the cool room and some in the dryers. The whole effort was more or less disastrous because the dryers were unsuitable for drying this type of fish and information was meagre concerning the handling of this type of fish. Spoilage could have been avoided to some extent, however, if the fish had been placed in the cool room in smaller bulks and so allowed to cool more rapidly. The news of this failure spread rapidly and the artificial drying of fish suffered a rather severe set-back all over Newfoundland.

Mr. Hunt left to join the staff of the Newfoundland Fisheries Research Station of the Fisheries Research Board at the end of 1950 and M. A. Foley was transferred to St. John's from Halifax to carry on the work of the Atlantic Fisheries Experimental Station in Newfoundland.

Pressure from the industry to experiment with the artificial drying of lightly salted fish on a commercial scale became great in the spring of 1951, so the preliminary basic research was waived and a direct approach was made to the problem. The data on work done by Dr. H. Fougère at the Gaspé Station, by Dr. E. P. Linton at the Newfoundland Fisheries Research Station and by A. L. Wood at the Experimental Station in Halifax were examined and assessed; finally a course of action was planned in consultation with Dr. Fougère and A. L. Wood. An agreement was made with a salt fish company in Bay Bulls, whereby the Board would install and operate a dryer of commercial proportions with the company supplying the raw material and selling the finished product.

The installation was completed late in the summer of 1951 at which time Dr. Fougère came to Newfoundland for consultations on salting and drying procedures. The efforts of the first year were not very successful, due mainly to the short season and insufficient trained staff; however some results were encouraging.

Mr. R. J. Noah, a chemical engineer, joined the staff in October, 1951.

Experimentation was continued in the spring of 1952. Mr. C. Blackwood, a food technologist, was added to the staff to conduct the work at Bay Bulls. Much better results were obtained due to the closer supervision and the experiment began to show promise from both the economic and quality aspects. However, it was felt that complete control from the time the fish came on the wharf was necessary to produce the best grades. A considerable quantity of fish was "down graded" because the company used more salt than was required for artificial drying. Considerable trouble was experienced with "Dun"; one shipment to Italy was badly contaminated on arrival which changed the thinking on storage and marketing procedures somewhat. Both the Gaspé and Halifax Stations commenced work on a commercial type "Dun" inhibitor.

It was felt that with the experience gained at Bay Bulls the time was opportune for the building of a complete salt fish plant where the whole operation from splitting to packing could be carried out. The design and construction of such a plant at Bonavista was handled by the Newfoundland staff of the Atlantic Fisheries Experimental Station, the plant commencing operations in July, 1953. The engineering staff of the Board directed the operations of the plant during the first season with good success quality-wise; the financial aspect being less promising due to the shortness of the season and the small quantity of fish produced. Approximately 70% of the lightly salted fish was of Madeira grade and above, and 80% of the heavily salted was Choice and Select grades. Both were considerably above the Newfoundland average for that year.

Mr. Blackwood left in the fall of 1953 to continue his education and has since joined the Federal Department of Fisheries, Mr. W. D. McDougall, a mechanical engineer, joined the group in January, 1954 and Mr. T. P. Carew, Technician Grade 2, in October of this year.

The staff as listed, with the addition of six summer students, has been engaged in all phases of fresh and salt fish processing. However, most effort has been devoted to the latter due to the urgency of the problem.

From January, 1950, to April, 1954, the Engineering Service of the Board was under the direction of Dr. S. A. Beatty of the Atlantic Fisheries Experimental Station in Halifax. The group became the Newfoundland Technological Unit as of the first of April, 1954, under the direction of the Fisheries Research Board Headquarters at Ottawa with routine administration being handled through the Newfoundland Fisheries Research Station.

Bonavista Experimental Salt Fish Plant

The Technological Unit was responsible only for general engineering service, major installations and maintenance for the past season.

A second Baader header-splitter machine was added during the year; the cool room capacity was expanded by about 75%; a new mechanical washer was added; air conditioners were installed in the dry store.

Members of the staff made numerous trips to Bonavista to install equipment and expand facilities, to correct mistakes and to repair defective machinery. Both the mechanical and electrical ends of the splitters gave trouble resulting in breakdowns and loss of production.

The fish produced has been, for the most part, of very high quality with a high percentage of Italian grade in the lightly salted fish. The reports from the markets in Italy have been

excellent. Production figures should be 50% above those of 1953; production probably would have been doubled except that strikes curtailed the intake of the plant.

It is hoped to modify some processing practices before the 1955 season and so lower the cost of production.

Andrews' Washer

A revised model of the Andrews' washer was constructed for trial operation at Bonavista. It has performed well and has cut the cost of the hand-washing of the previous season by about two-thirds.

The fish is placed nape first, skin side up, on an inclined conveyor belt 18 inches wide which travels under two sprays and two cylindrical revolving brushes. It falls from this belt onto a second one - face up - and under sprays and brushes as on the first belt. It has washed heavily salted fish at the following rates during production, not on time trials.

Small (12 to 18 in.)	-	2694 lb. per hour
Medium (18 to 23 in.)	-	4494 lb. per hour
Large (above 23 in.)	-	7120 lb. per hour

The rate for lightly salted fish is much the same. However, the face of this fish is merely sprayed as brushing tends to roughen it. Fish of this type that was soft before splitting is not handled by the machine readily or well. In fact, soft fish is costly to process all along the line and gives a poor quality end product.

It may be seen from the above figures that small fish are far more costly to work; this is true throughout the production picture - from splitting to packing.

It is felt that this washer can be further modified to make it a more compact and efficient machine. The machine can be decreased in length, improved mechanically and made more readily mobile so that it can be moved to the fish to be washed.

Plywood Pickle Tank

A small, prefabricated pickle tank was designed and built using four, 4 ft. by 8 ft. by $\frac{3}{4}$ in. sheets of Douglas Fir plywood. The tank was designed so that the component parts could be fabricated at a wood working shop and shipped to the point of usage in a "knocked-down" package and there erected with a minimum of labour. Threaded steel tension rods are used to erect the tank rather than nails or screws. The tank is 4 ft. deep, 3 ft. 6 in. wide and 7 ft. 6 in. long and the component parts can be made for about $180 depending on locality and number required.

A tank of this type has been in use at Bonavista during the past season. No difficulty has been experienced in keeping it tight. It must, however, be levelled before use so as to avoid undue strains. The tank has been in use for too short a period to give any idea of its useful life.

Splitting Machines

One Baader header-splitter for the processing of salt fish was installed at the Experimental Salt Fish Plant at Bonavista in 1953, a second unit being added in 1954. During the 1953 season the machine turned out well split fish and little difficulty was experienced after the initial adjustments were made. Break-downs were few and of a minor nature. While the economic advantages over hand splitting was rather indefinite the general excellence and uniformity of splitting made the machine most worthwhile.

The old machine did not perform as well in 1954 and the new machine began to miss also during the latter part of the season. There were frequent mechanical and electrical break-downs which, at times, interrupted production for rather long periods.

It is hoped to give both machines a complete over-haul during the off-season and to replace any worn parts. The Baader Company will be furnishing a complete parts list which will help greatly in making repairs.

General Engineering Services

The Technological Unit has received requests for designs, layouts, information and opinions on most phases of the fresh and salt fish industries. The Unit recently completed plans and specifications for the Valleyfield salt fish experimental plant and for a small salt fish plant for the Newfoundland Fisheries Development Authority. Trips have been made to most fishing areas in Newfoundland by car, plane and ship for assessing existing facilities, for plant site selection and to confer, to give opinions, to inspect and to supervise installations. Engineers of the Unit, in conjunction with the Federal Department of Fisheries, made surveys of almost all fish plants in Newfoundland preparatory to the drawing-up of minimum requirements and regulations for plants under the Federal Inspection plan. The Unit helped draw up proposed plant specifications for Newfoundland.

M. A. Foley